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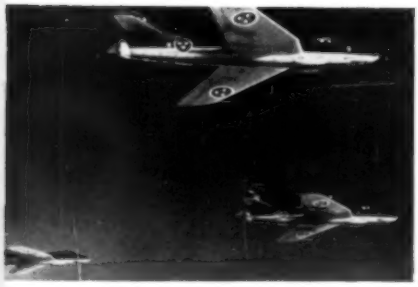

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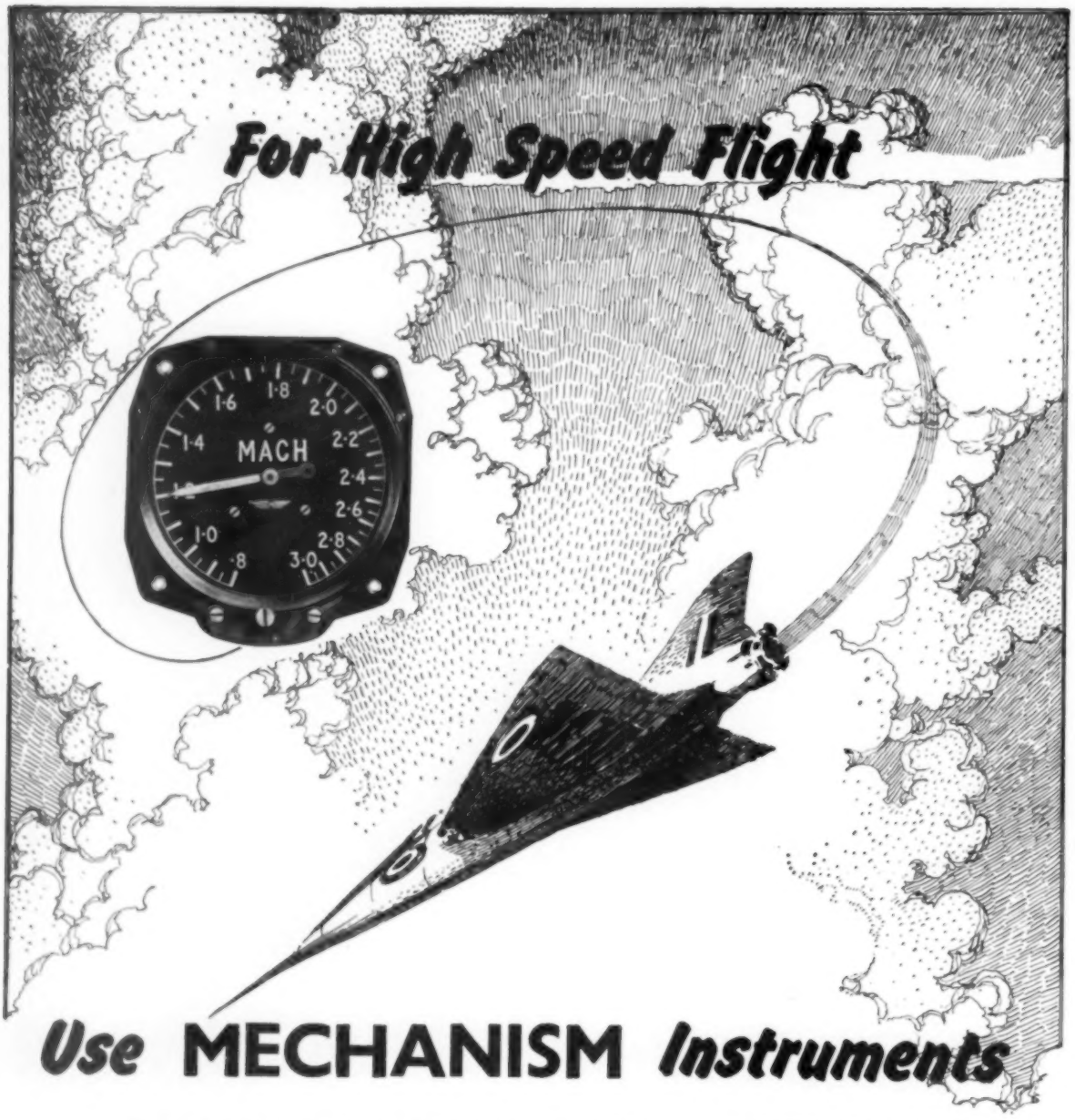

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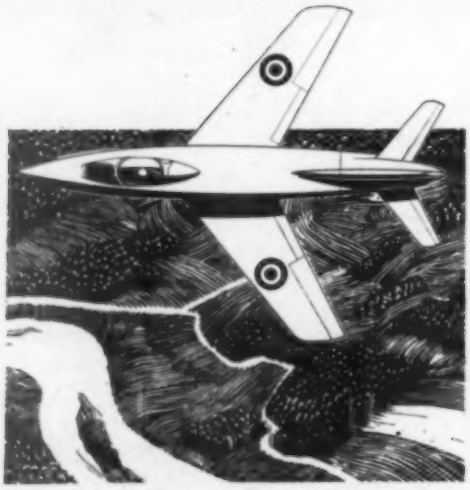

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I'm sorry, but we're only at the seventh and I've done nothing but listen to you blabbing on about the Firth Cleveland Flowmeter. Who cares?

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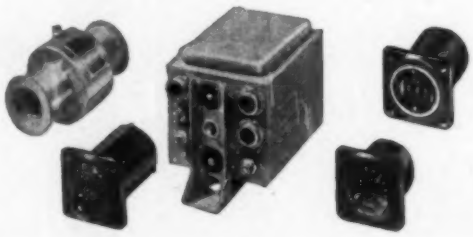

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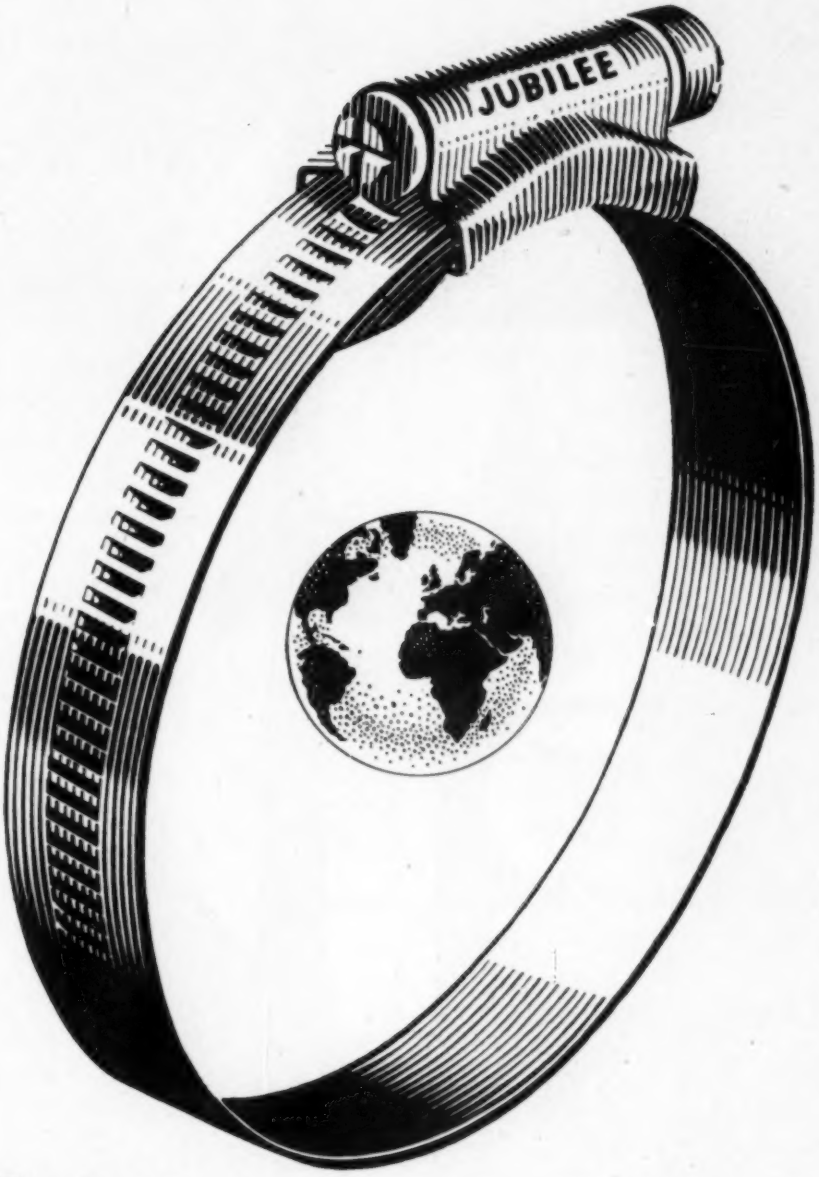
IN THIS GEOPHYSICAL YEAR — remember



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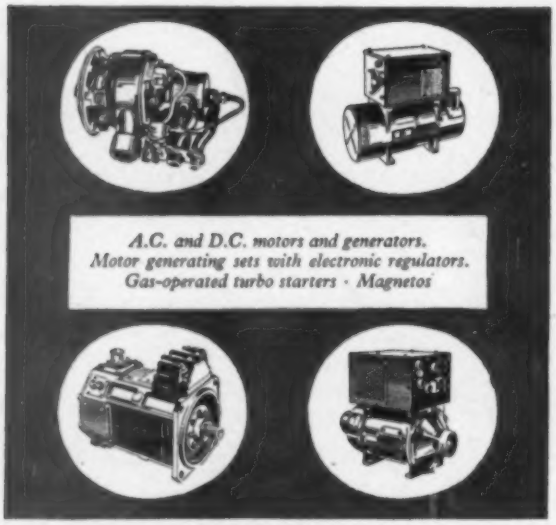
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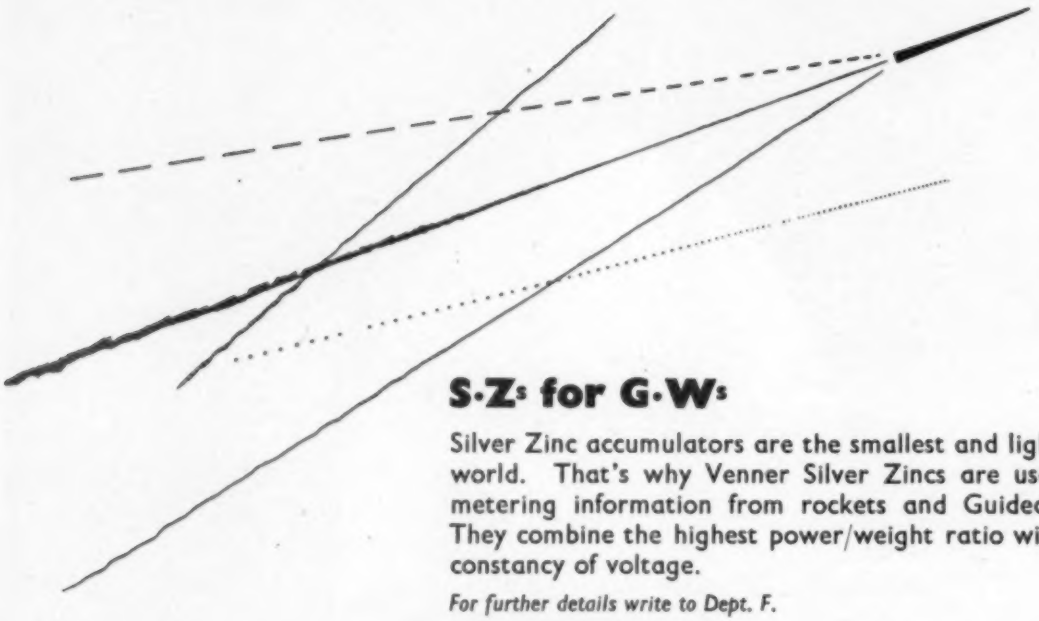

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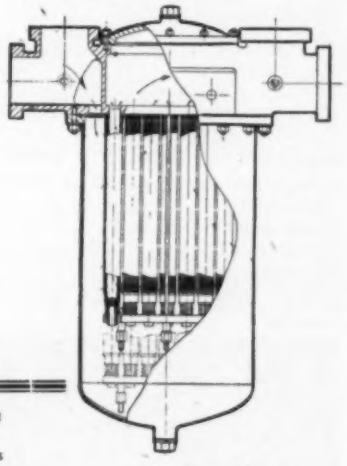

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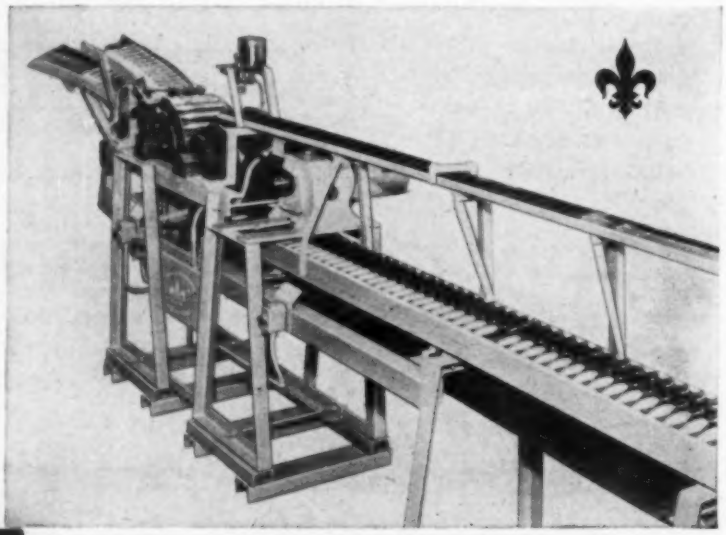

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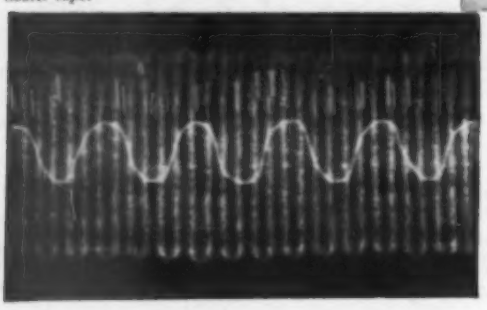

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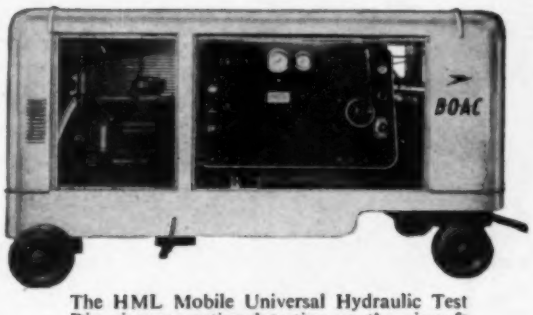

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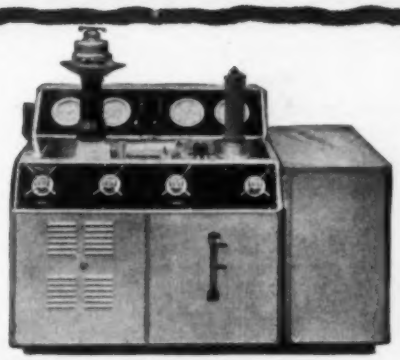

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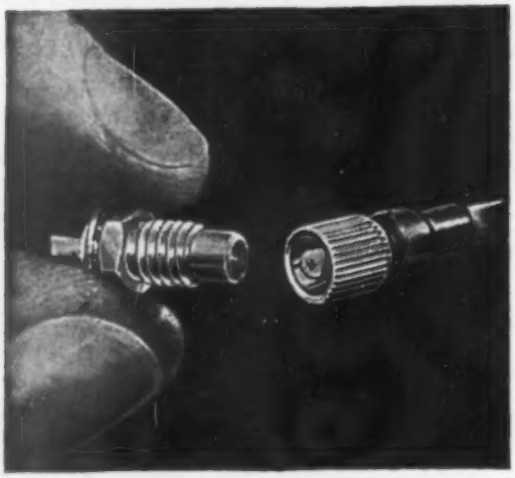

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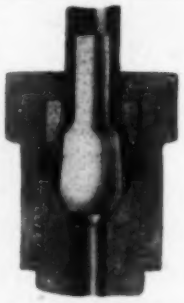

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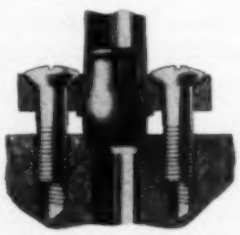
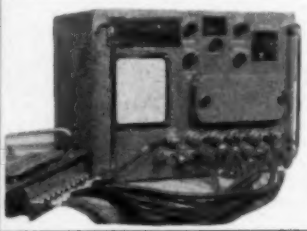


As with the Type I above this coupling consists of a specially designed nipple with a surface which forms an impregnable junction ring when brought in contact with the conical flared outlet of the pipe. It is, however, far lighter in weight and is intended for use in new designs rather than for adapting existing installations.



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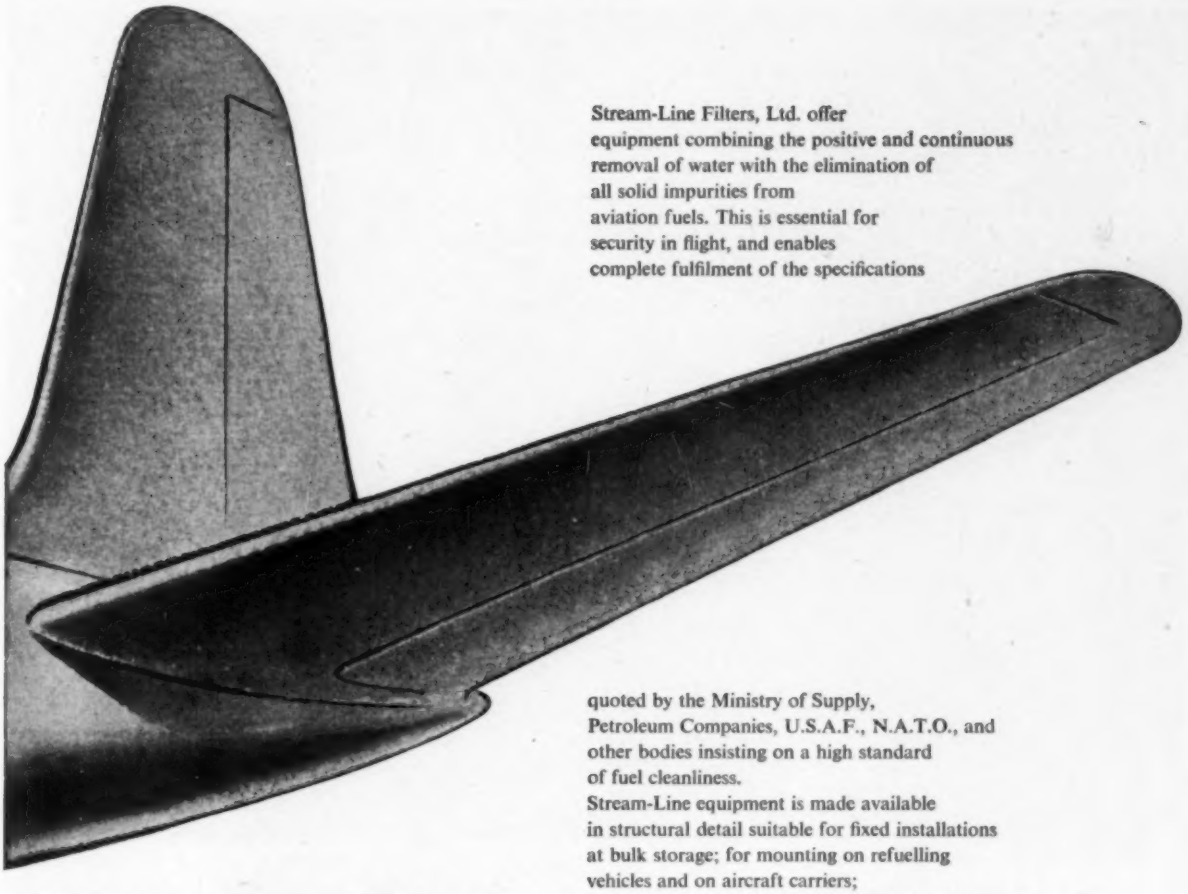

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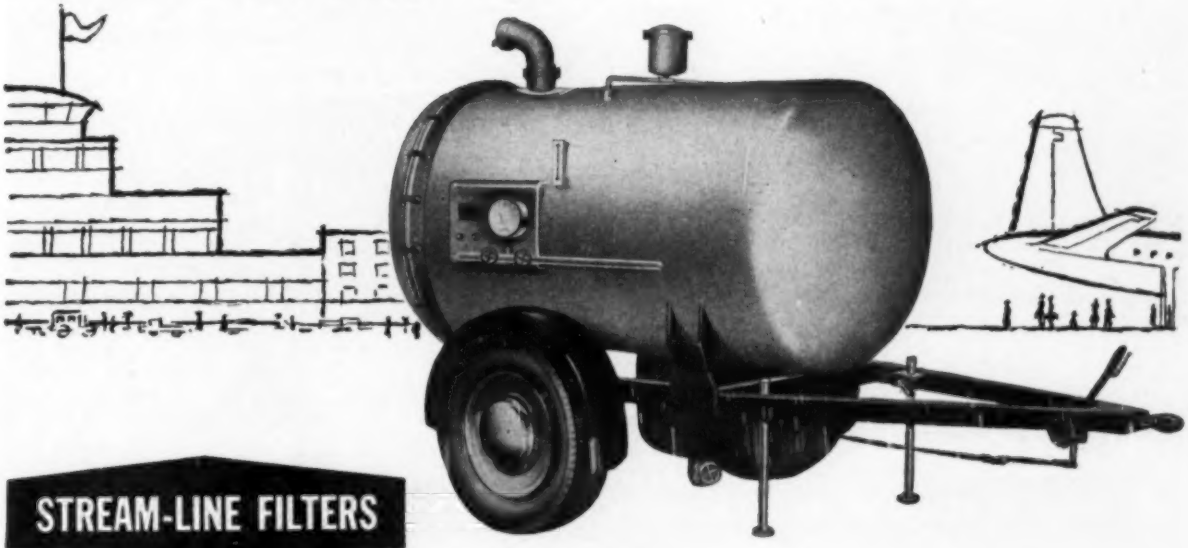

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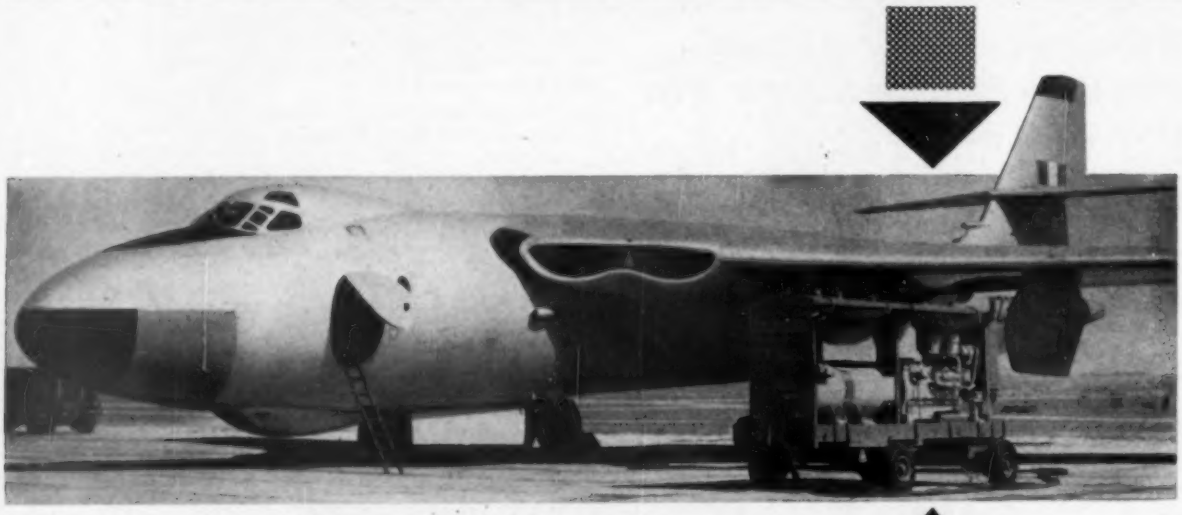

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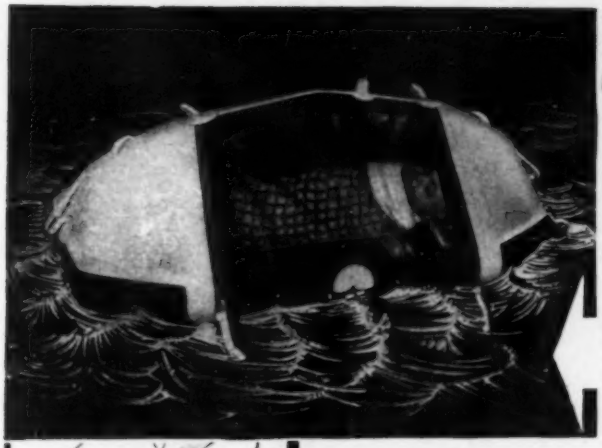

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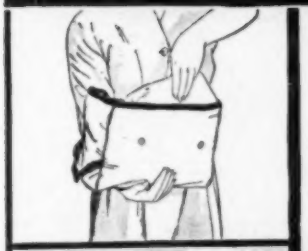

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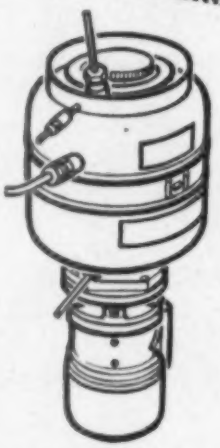

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FLIGHT
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No 2590 Vol 74 FRIDAY 12 SEPTEMBER 1958

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London, S.E.1
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New York, N.Y.
Thomas Skinner and Co. (Publishers), Ltd.
111 Broadway, 6
Telephone · Digby 9-1197

ANNUAL SUBSCRIPTION
Home £4 15s 0d, overseas £5 0s 0d.
Canada and U.S.A. $15.00.

Second Class Mail privileges authorised at New York, N.Y.

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Would Any Gentleman—?

NOT so long ago, as every Farnborough-week opened, the professional and amateur hecklers of the British aircraft industry loved to gather round for a little chant that went something like this: "Too many prototypes. Not enough production. Where's all the business?" One or two items of information that have lately been brought to their attention—in particular the 50 per cent increase in export figures for the first six months of this year—have obliged them to change their tune; and we now proffer a further item.

It is one which has never been publicized—if, indeed, it has yet been appreciated at all; and it dawned on us in a moment of truth at Farnborough.

The simple facts are these. In the display this year there were 34 basic types of aeroplane (if we exclude variants, test-beds and research aircraft). Of this number, no fewer than 30 are already the subject of orders—which, without bringing in the technical editor and his slide-rule, is just under 90 per cent. Of the same 30 a total of 28 have been ordered by Great Britain and 18 are booked for the British market and for export also. The only types that are not on order as we write are the Beaver Series 2 (a development of the best-selling Series 1), th Fairey Ultra-Light, the Saunders-Roe P.531 and the Westland Westminster.

Now would any of the erstwhile heckling gentlemen care to step forward and place even money that the aforenamed aircraft will not be sold, either at home or abroad? Or would he care to join us in preparing a nice big showcard for Farnborough '59 to read "Lines selling one hundred per cent."

[**Farnborough Stop Press.** Since the above was written the S.B.A.C.'s president has himself dealt with the "Hold-Farnborough-every-*other*-year" type of heckler by declaring that there will be enough new aircraft for a full show in 1959, 1960 and 1961—with 1960 a vintage year.]

Rate For The Job

IN the noisy debate on jet-age fares one voice was surprisingly subdued. It belonged to that influential and respected weekly, *The Economist*. Then, a few weeks ago, an article appeared contending that jet surcharges were wrong because cost differences between turboprop and turbojet were marginal.

While recognizing that everybody is entitled to his own opinion on this matter of costs—and it will be many months before anything other than opinion can be ventured—it seems to us that the problem is not one of establishing a revenue rate for each individual aircraft type but of framing a set of fare-levels that will together yield the greatest possible revenue. Yet *The Economist* argues that this is equivalent to "insisting that an airline must price itself out of the market."

Using the big new turbojets, airlines will be able to offer their public a standard of service hitherto unknown. While this will attract to the air a small volume of traffic that at present travels either by surface or not at all, a more significant effect will be to make air travel more valuable for those who already find today's schedules too slow. But at least in their initial period of use these attractive aircraft are probably going to be relatively expensive; indeed, most turbojet-airliner manufacturers have dropped their claim of offering cheaper vehicles, and are now content to use such terms as "comparable" or "equivalent." Payloads will necessarily be sacrificed by the need to satisfy noise and safety requirements, while performance will be reduced and utilization cut by the lack of suitable facilities.

Even more important, the very introduction of these jets will make it worthwhile for existing piston and turboprop aircraft to be operated at lower fares rather than not at all. If no appropriately low fare-levels are found, the slower aircraft will have to be either operated expensively or sold at a loss. Accordingly, it is not just the operators of turboprops who stand to gain from a differential fare but all those carriers who will have too many slow aircraft.

Introduction of lower fares for slower services would allow the mass market to be developed by obsolescent piston aircraft or ultra-cheap turboprops.

FROM ALL QUARTERS

Rotodyne Order Announced

AT Farnborough on Thursday of last week, Mr. G. W. Hall, chairman and managing director of the Fairey Aviation Co., Ltd., announced that the first order for a Fairey Rotodyne had been placed by the Okanagan Helicopter Group, of Vancouver, B.C. Mr. Glenn W. McPherson, president and managing director of Okanagan, who was with Mr. Hall on this occasion, said that the machine would be used for intercity passenger services, not necessarily based on Vancouver, up to stage-lengths of 150 miles.

Delivery of the aircraft, according to Mr. Hall, would be made in 2-3 years' time. The price was still to be negotiated, but the most recently quoted price for the Rotodyne was £375,000. At present Okanagan operate 32 Bell 47s, 21 Sikorsky S-55s and one S-58 on bush and defence-site operations across Canada.

Royal Helicopters

TWO Westland Whirlwinds have been ordered for the Queen's Flight. They will be designated Mk 8s but will be basically the same as the Mk 7 except for having dual controls, four passenger seats instead of eight, and special furnishings.

Hawker Siddeley Reorganization

A CARD on the Hawker Siddeley stand at Farnborough, worded "Hawker Siddeley (Aviation Division)", confirmed an earlier rumour that a major reorganization is taking place in the Group's business. Although no official announcement has been made at the time of going to press, it is understood that the new move is aimed at consolidating the Group's various aeronautical interests into a single entity. The firms concerned are likely to be A. V. Roe, Armstrong Whitworth Aircraft, Armstrong Siddeley Motors, Gloster Aircraft, Hawker Aircraft, Air Service Training and the two Canadian companies, Avro Aircraft and Orenda Engines.

Black Knight

SINCE page 445 went to press, the hope there expressed has been realized; Black Knight, our largest research rocket, has successfully flown and basic details can be divulged. Those principally responsible for Black Knight are: the G.W. Department of the R.A.E., Farnborough; R.A.E./R.P.D., Westcott, who designed the rocket motor; Saunders-Roe, Ltd., who constructed the airframe and managed the Needles rocket testing site on behalf of the M.o.S.; and Armstrong Siddeley Motors, Ltd., Ansty, who have been responsible for the manufacture and final development of the powerplant. It seems likely that the latter is the 50,000 lb-thrust liquid-propellant unit whose welded chamber has several times been exhibited by the M.o.S.

It has been stated that Black Knight is 35ft long and has a body diameter of 3ft. Its primary purpose is apparently to serve as the re-entry test vehicle for the Blue Streak LRBM, and it seems to have a single stage. It is intended to climb steeply (initially vertically) on a pre-programmed course, the flight beyond cut-off being ballistic. At the apogee there is, presumably, some stabilizing and control system for returning the vehicle to a nose-down attitude and the re-entry is thereupon accomplished as a free fall. Although the apogee is clearly at least 150 miles, it is surprising to find such a system reaching a re-entry speed comparable with that of a long-range ballistic missile. Comparable American test vehicles—admittedly smaller—have been multi-staged, the final stage being fired during the descent.

FIRING DOWN UNDER: Extremes in size among missiles fired at Woomera are Black Knight (left, and described above) and Malkara, the Australian anti-tank weapon, 150 of which have been purchased by the British Ministry of Supply. The Malkara is on its launcher, which can be mounted on a vehicle.

The photograph, taken at the R.A.E., shows a nose cone similar to that of the U.S. Army Jupiter (tip radius barely 6in, included angle about 16 deg), but a radioed picture from Woomera, unsuitable for reproduction here, shows a cone with an included angle of about 35 deg, and this was apparently the one fitted during the actual firing. The latter took place on September 7 and was described as "an extraordinary success." The first round telemetered data back to the ground and the nose cone—presumably damaged by impact, if not by the re-entry—was recovered.

Fair Exchange at Madrid

BY the time this issue appears the First International Congress of the Aeronautical Sciences will be drawing to its close at the Instituto Nacional de Prevision, Madrid. The congress has been organized by the International Council of the Aeronautical Sciences, which was formed last year by the aeronautical and scientific societies and institutions which constitute the membership of the 20 countries participating in the present congress.

It was felt at the time of the Sixth Anglo American conference at Folkestone in 1957 that the scope of the technical exchange could be widened to include more than the two participating countries, and an announcement made in the closing stages of that conference, that an international meeting would be held in Madrid, received wide acclaim. It was also well received that Dr. Theodore von Kármán, chairman of the Advisory Group for Aeronautical Research and Development, would be the first president of the I.C.A.S. and would preside at the Congress. The president of the executive committee of the I.C.A.S. is M. Maurice Roy, director of l'Office National d'Etudes et de Recherches Aeronautiques (O.N.E.R.A.) in Paris.

During the Congress, which was scheduled to open at 10.30 a.m. last Monday, September 8, 45 papers are being presented. Ten of them are being given by United Kingdom authors from among the 60 members of the Royal Aeronautical Society—led by the president, Sir Arnold Hall, and the secretary, Dr. A. M. Ballantyne—who are attending. Papers on the first day were being given by Dr. von Kármán himself, who was reading the Daniel and Florence Guggenheim Memorial Lecture, and by Ing. Pedro Blanco, who was to follow by reading the Juan de la Cierva lecture.

The lectures have been arranged in general sessions, with papers of interest to most of the delegates and "special sessions" dealing with many of the current problems engaging aeronautical engineers and scientists: hypersonic flow, the "heat barrier," jet engines and noise, boundary layer control, VTOL and STOL, navigation, guidance, telecommand and telemetering.

Presenting the Boeing 707

LONDON Airport made its acquaintance with the Boeing 707-121 last Monday, when Pan American's first aircraft of this type, N709PA *Clipper America*, arrived for noise-assessment trials by the Ministry of Transport and Civil Aviation.

The big jet arrived on schedule at 8 a.m. after a two-stop crossing from New York via Gander and Shannon (a non-stop flight was not attempted, because of the 190,000 lb weight-limitation at New York). During the 707's brief stay the Ministry assessed its apron taxi-blast behaviour and measured noise-levels at a point three miles from the start of take-off, which was westbound from No. 5 runway. Take-off weight was 190,000 lb.

At a news conference, questions were asked about plans for introduction to service, and about reports of a ground-stall condition (*Flight*, August 29). PanAm spokesman Mr. Harold Gray (executive vice-president, Atlantic Division) was rather non-committal on both subjects. Of the ground-stall he said: "If I started out to deny all rumours about 707 troubles it would take me all day."

When would transatlantic services begin to London? At first Mr. Gray answered indirectly, but later said that "early November" was the probable date in mind, but it was not certain whether London - New York would be the first route. Everything depended, he said, on certification. Tests were completed, but much paper work remained. Later Mr. Gray said that PanAm expected to receive their first fully certificated machine on

September 19, and two others before December. Capt. Scott Flower (skipper on the London flight) pointed out that several things had to be "ironed out" between Boeing and the C.A.B. before certification could be granted.

The PanAm representatives were asked how many proving flights would be made, and how many 707 hours each captain would have before the start of public services, but were not willing to give this information.

Boeing's chief of flight test, "Tex" Johnston, was on board the aircraft, as also was his assistant Jack Wadell. After the news conference Mr. Wadell commented on lingering doubts about the ground-stall problem by saying, "A 707 never has had a ground-stall." Nevertheless, Boeing last week announced the fitting of retractable leading-edge flaps to all 707s "to help maintain a high level of . . . performance no matter how much the nose is raised at take-off."

Other facts which came to light were that PanAm's 707 services eastbound would be non-stop "under normal conditions" when New York's longest runway had been extended from its present 8,400ft to 11,200ft next January; that the JT3C engines will enter company service with an 800-hr overhaul life; that PanAm consider it "proper" to carry a flight engineer on the 707s; that they will get their first 707-321 next summer; and that they do not consider the differential fare economically justifiable.

Argentine Comet Plans

LAST Friday, September 5, the president of Aerolineas Argentinas, A. Cdre. Juan Jose Guiraldes, spoke in London about his airline's Comet 4 plans. The first three of six aircraft ordered will be delivered from next February, and services from Buenos Aires to New York and to London will start in May. [B.O.A.C. do not intend, on present plans, to re-open their South Atlantic route—which they will do with Comets—until 1960.] The next three Comet 4s will, Aerolineas' president said, be delivered from June 1960.

Other salient points made by A. Cdre. Guiraldes were that Comet 4 utilization will be 9 hr 20 min per aircraft per day; that the weakness of American sales efforts to small airlines was that traffic was not sufficient to fill aircraft bigger than the Comet; and that the £10m Comet 4 order is being financed by British banks and by Air Finance, Ltd., the loan being repayable over 6½ years at 6½ per cent interest.

Footnote: On its flight to Hong Kong last Monday B.O.A.C. Comet G-APDA, operated by D.H., gave demonstrations to Misrair in Cairo and to Air-India in Bombay.

Helicopter Association Entertains

GUESTS from several foreign countries were among those present at the twelfth annual dinner of the Helicopter Association of Great Britain, held at the Dorchester Hotel, London, on the Thursday of Farnborough week. They included Mr. Igor Sikorsky, the eminent pioneer of helicopter manufacture.

Proposing the health of the Association, Sir Cyril Musgrave (Permanent Secretary, Ministry of Supply) said that confidence in the helicopter was being demonstrated in the most convincing way—the manufacturers themselves were committing more of their own money to developments. He noted that five completely new helicopters had flown in the year since the previous dinner.

The Association's president, Mr. Eric Mensforth, was in the chair and replied to the toast. On the subject of production, he emphasized that in order to produce quickly and practically one must have reasonably adequate resources, experience, faith and immensely hard work. In this country it was a great asset to have such a choice of engines and such a wealth of ancillary equipment inherited from the fixed-wing section of the industry.

The president announced that Dr. James Bennett [Professor of Aerodynamics at the College of Aeronautics] had been elected the fourth honorary member of the Association and Mr. Igor Sikorsky the fifth.

Replying to Mr. Mensforth's toast, Mr. Sikorsky amused his audience with his opening remark that he had been connected with helicopters "for the last 50 years of my life." After mentioning some of his early experiments and experiences he said that the finest achievements of the helicopter had been in the last few years; and in support of his contention that the helicopter had reached maturity he quoted the case of Clarence Belinn's Los Angeles Airways, which for eleven years had never missed a day of operation, had made 100,000 landings on the roof of the post office in down-town Los Angeles, and of whose aircraft some had flown over 10,000 hours.

Before reviewing a very large number of helicopter operations in various parts of the world, Mr. Sikorsky made some predictions and observations which he stressed were "strictly personal". The helicopter, he said, would never be very fast; a maximum speed of 200 m.p.h. could be approached and Rotodyne-like types might perhaps be 50 to 75 m.p.h. faster; these had a place but would not replace pure helicopters. Convertiplanes would, of course, be much faster, but they would never occupy more than a very small sector of military usefulness.

Without doubt there was a great future for the amphibian helicopter, though not for the amphibian aeroplane. The S-62 was now fully tested and was the first pure, true amphibian. The gross weight was 7,500 lb and the payload as an amphibian 3,000 lb. In land form the payload was only 220 lb more, a mere 7 per cent. There was no other penalty for being amphibious, either in flying performance or control. It was ideal for pioneering work.

Next, Mr. Sikorsky recalled the importance of the cargo-crane type of helicopter and its ability to overcome the limitations of land transportation—clearance under bridges, between obstructions, and so on. Another point of great importance to helicopters, he said, was automatic stabilization. In future civil operations reliability and regularity would be paramount. A speed of 150 m.p.h. would be enough.

During the course of the evening the president presented the Alan Marsh Memorial Medal to Lt-Cdr. G. G. R. Miller, R.N., who is now with the Ministry of Supply. The citation read: "For outstanding achievement as a helicopter pilot and for success in the promotion of the study of rotary-wing flight by his courageous demonstration of night pilotage when, on 16 December, 1957, while serving with No. 701 squadron, R.N., he made an emergency ambulance flight under extremely adverse conditions."

The Alan Marsh Award—for exceptional ability in technical study in the rotary-wing field—was made to a student of the Association, Mr. Kenneth F. Topp.

PIONEER helicopter designer Igor Sikorsky at Farnborough with the Westminster, Westland test pilot Jack Fraser (left) and Capt. Rolf von Bahr (Westland special representative in Sweden and Denmark). Mr. Sikorsky also met Mr. Bob Graham, director of Microcell, Ltd., and the first Englishman to fly a helicopter (in 1925).

IN BRIEF

It was announced last week that Prince Alexander of Yugoslavia has joined the Fairey Aviation Co., Ltd., as NATO sales representative. He will be based in Paris.

* * *

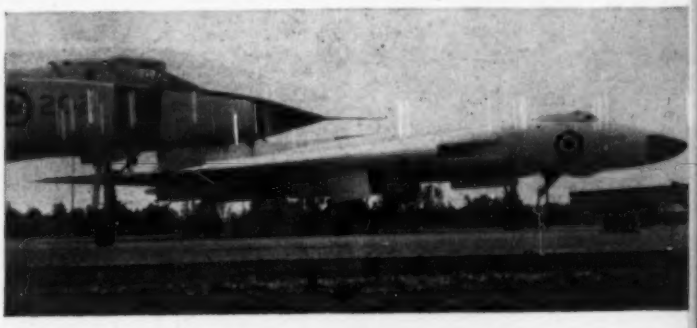
On August 27 a Russian single-stage I.G.Y. rocket carried two dogs to an altitude of 280 miles. The animals—together with various recording instruments—were recovered by parachute in good condition. Total load lifted by the rocket amounted to 3,724 lb.

* * *

The Court of the Worshipful Company of Coachmakers and Coach Harness Makers has elected the following officers for the ensuing year: Master, Mr. R. J. D. Smith; Senior Warden, The Hon. Denis Berry, T.D.; Renter Warden, Sir Reginald Verdon Smith; Junior Warden, Col. G. A. Norris, O.B.E.

* * *

The Aircraft Recognition Society is holding its first meeting of the autumn on September 17, at 7 p.m. in the R.Ae.S. library, 4 Hamilton Place, Park Lane, London, W.1. Principal speakers will be Lorne and Ann Welch, the well-known gliding exponents. "All readers of *Flight*," says the A.R.S., "are welcome."



TRANSATLANTIC TRIANGLES: The two great Avro deltas met last week when, as recorded on p. 442, an R.A.F. Vulcan took part in displays at Farnborough and Toronto on the same day. It is seen here, with the second Arrow Mk 1 long-range bomber-destroyer.

Astronautics in Amsterdam

By KENNETH W. GATLAND, F.R.A.S.

Prof. L. I. Sedov (U.S.S.R.) illustrates a point in his paper on the motion of satellites.

AS briefly reported in *Flight* last week, at the ninth Congress of the International Astronautical Federation, held in Amsterdam from August 25 to 30, scientists, engineers and lawyers representing some 20 nations, including the U.S.S.R., the United States and Great Britain, discussed a wide variety of topics ranging from rocket and satellite technology to the tricky problems of space-law. But in the corridors and meeting rooms of the Municipal University, where the technical sessions were held, there was much informal debate on ways and means of European and other countries joining in space-research. A NATO programme was one possibility, whilst another was a joint enterprise by the British Commonwealth. This latter prospect, which has been urged by the British Interplanetary Society for some time, was taken a stage farther by the decision of delegates representing Great Britain, Canada, the Union of South Africa, and India, to form immediately a committee on astronautics, with the view to holding a Commonwealth space-flight conference in London next September.

It is impossible to cover here more than a few of the 80 or more papers presented at the technical sessions of the Congress, and this review is restricted to astronautical subjects which have more immediate practical interest.

A very warm reception was given to Dr. Wernher von Braun, who was making his first appearance at an I.A.F. Congress. His subject was the Explorer satellite project, and after outlining the general characteristics of the Jupiter-C four-stage carrier he gave some hitherto unpublished details of the launching procedure.

Jupiter-C takes off vertically under its own thrust of 83,000 lb. During the 155-sec burning time of the first stage it is tilted into a trajectory which is inclined approximately 40 deg to the horizon at cut-off. A few seconds after cut-off the booster is separated from the instrument compartment. This is done by igniting six explosive bolts which secure the compartment to the front end of the tank section of the first stage. Wrapped around these bolts are six coil springs which have been pre-loaded during the assembly procedure. At the moment the attachment bolts are destroyed the springs exert a gentle push on the instrument compartment and separate it cleanly from the booster.

"Since only the weak spring forces separated the instrument compartment from the booster," von Braun continued, "we had to ensure that after separation the booster would not collide with the instrument compartment as a result of the residual thrust. For this reason we allowed the complete vehicle to coast for about five seconds and permitted the thrust to decay completely down to zero before actual separation occurred." The same gyroscopes which had controlled the vehicle up to the cut-off point (by means of four refractory vanes disposed in the efflux) would, after separation, control a system of compressed-air nozzles mounted in the tail of the instrument compartment. The reaction thrust of these nozzles tilted the entire nose-section, complete with the spinning cluster of high-speed rockets, into a horizontal plane.

Although this separation technique appears to have worked well in the case of the first Explorers, the failure of Explorer 5 on August 24 was in fact (the lecturer said) due to a run-up of the separated booster into the back of the control section, tipping the latter over. This upset the action of the gyros for correct horizontal alignment of the three final stages, and the satellite did not orbit.

Held jointly with the Congress was the Colloquium on Space Law, under the chairmanship of the eminent U.S. authority, Andrew G. Haley. He is seen speaking, and on his left are Dr. Gerloch and Dr. Welf Heinrich, Prince of Hanover, both from Germany, and (nearest camera) Kenneth W. Gatland, vice-chairman of the British Interplanetary Society, who has contributed this report on the Congress.

The object with Explorers 4 and 5 had been to investigate the belt of intense radiation (first discovered by Explorer 3) which exists some hundreds of miles above the earth. To this end the temperature gauges, micro-meteorite detectors and tape-recorder of Explorer 3 were sacrificed to accommodate additional radiation counters, with the aim of breaking down the count into different levels of intensity. The instrumentation was therefore restricted to Geiger tubes and scintillation counters, some of which were lead-shielded to eliminate data below certain energy levels. At certain heights of its orbit the Geiger tube carried in Explorer 3 was completely swamped by the radiation, and subsequent laboratory investigation indicated that such complete blanketing would require a counting rate of at least 35,000 impacts per second. It was further concluded that only a small portion of these rays could be of high-energy classification, identified as cosmic rays, and that most of the count was made up of a little known low-energy type, presumably either electrons or protons of solar origin.

In a paper presented jointly by Dr. James Van Allen, Carl McIlwain, and George Ludwig, of Iowa State University, information was given on the radiation measurements obtained with Explorer 4. They found that radiation varied both in quantity and quality with latitude and altitude. A low-energy component was usually present with the relative number of high-energy particles increasing as the magnetic equator was approached. Many of these particles must have energies exceeding six megavolts if electrons or 40 megavolts if protons.

An ingenious theory to account for the radiation belt was given by Professor S. F. Singer of Maryland University, who considers that cosmic rays may be responsible. Primary cosmic rays, he said, smash into the earth's atmosphere in the vicinity of 70,000ft and disintegrate atmospheric nuclei. Neutrons are released with energies up to several hundred-million electron volts, many of which travel upwards and are therefore known as "cosmic-ray albedo." Being uncharged, the neutrons travel along straight lines, right through the earth's magnetic field and out into space. But free neutrons are radio-active. A minute fraction of them change into protons while travelling through the field (about 10^{-13} per cm, or about one in a million per 100 miles). These protons immediately spiral around the lines of force; a fraction are lost immediately as they get back too deep into the atmosphere, but the rest are trapped. A typical injection rate is 10^{-13}/cm^3-sec (i.e., one particle is injected into a given cubic centimetre of space every 30 million years); but the "lifetime" is so long that the particle concentration builds up to 10^{-4} per cubic centimetre at 600 miles.

According to this theory, a maximum intensity is reached at the equator at about 6,000 miles, beyond which the intensity drops to the normal background level probably near 10 earth radii, where the interplanetary magnetic field is believed to take over. Singer has calculated that, at an altitude of about 600 miles, an energy flux of about 100 erg/sq cm/sec could be reduced by 4 mm of lead shielding to about 60 per cent. Under these conditions a man would accumulate a maximum "life-time dose" of 100R in about three hours' exposure.

At higher latitudes the radiation belt is much thinner, and at the poles it is absent. This means that if launchings were made from the polar regions rockets could escape up a "tunnel" virtually free of radiation made clear by the shape of the earth's magnetic field.

If subsequent experiments confirm the theory it will mean that the operation of manned satellites would not be feasible between altitudes of 250 and 40,000 miles without heavy biological shielding, which might render any such project entirely impracticable. Another suggested possibility is "magnetic screening"; by putting a coil around the space station with its axis parallel to the line of force we can create a small-scale dipole field which turns away the incidental radiation. However, as the power required is quite stupendous (36 MW for an aluminium coil of cross-section 10 cm × 10 cm), Professor Singer was not very optimistic. Finally, he said, there was the possibility of "sweeping out" the radiation by sending up large satellites which would absorb any protons they encountered. This scheme might work, because the injection

rate was so low. The cross-sectional area of the swept-out channel was quite large, so a reasonable number of "sweeper satellites" could reduce the radiation belt to tolerable limits.

An analysis of the scientific results obtained with the Explorer satellites was given by A. R. Hibbs of the Jet Propulsion Laboratory, California Institute of Technology, who reported some interesting facts concerning the micro-meteorite experiments conducted with Explorer 3, which in addition to impact microphones carried a set of 12 wire gauges. Each gauge was approximately 1 sq cm in area and was wound with two layers of enamelled wire 17μ in diameter. Impact of micro-meteorites of approximately 10μ diameter or larger causes the fracture of such a gauge. The gauges were mounted as a parallel resistance network so that the fracture of any one caused a change in the frequency of the sub-carrier oscillator of the telemetry circuit.

Not more than one of the gauges was broken during the lifetime of the telemetring system of Explorer 1, which had established an upper limit for the influx of particles 10μ or more in diameter of 10^{-3} particles sq m/sec during the period of the experiment (January 31 to April 14).

Data received from Explorer 3 showed no wire gauges broken until May 6. Then, between 2243 G.M.T. on May 6 and 0232 G.M.T. on May 7, two of the gauges were fractured. An interesting series of events followed. On May 8 and 9 erratic behaviour was observed in one of the telemetering channels on the low-power transmitter. After 0415 G.M.T. on May 9 no signal at all was picked up from this transmitter. During May 10 and 11 the Minitrack receiving stations indicated intermittent operation of the high-power transmitter, and after May 11 no further signals were received for several days. Then, quite unexpectedly, both transmitters returned to operation. However, the low-power transmitter carried no telemetry signal, and the operation of the interrogated beacon was intermittent.

Mr. Hibbs said that the breakdown of these two transmitters (which operated quite independently, with separate circuitry and power supplies) within one or two days of each other, simply by virtue of coincidental power failures, was unlikely. But one other piece of information must be taken into account: all other micro-meteorite data had been taken during periods of normal background activity. No meteor showers were encountered. However, the shower η Aquarides, which had been associated with Halley's Comet, occurred during the early part of May, reaching its most intense activity on or about May 5. It was reasonable to speculate, therefore, that some form of internal damage was caused by the impact of meteorites.

Professor L. I. Sedov of the U.S.S.R. took as his theme *The Dynamic Effects of the Motion of Earth Satellites*; he said that analysis carried out with Sputniks 1, 2 and 3 had shown that the perturbations of the motion of artificial satellites by the Sun and Moon were very small, and there was at present no need to take them into consideration. In determining the sputniks' orbits, no fewer than 60,000 measurements were processed from radio measurements and about 400 from optical observations for Sputnik 1; 12,800 radio measurements and 2,000 optical observations for Sputnik 2; and (as at July 7, 1958) 52,750 radio measurements and 1,260 optical observations for Sputnik 3. These data were processed on high-speed electronic machines and the elements of the orbits computed. Prof. Sedov presented several tables and graphs showing the results of these computations.

In view of the results revealed by Prof. Sedov it was particularly gratifying to note from R. H. Merson's paper that the R.A.E.'s radio and optical tracking stations had achieved accuracies which, in some cases, outmatched the Russian. Tabulated data on the orbit of Sputnik 2 included details which for one reason or another were omitted from the Soviet paper.

A second Russian contribution, by Prof. V. I. Krassovsky, gave some preliminary results obtained with Sputnik 3, which confirmed the existence of the radiation belt. Many speakers complimented the Russians on their achievement of launching this 26 cwt. satellite-laboratory, which appeared to be working well in many fields of geophysical investigation. In view of the large variety of instruments carried, however, it would be some time before the full range of this information could be processed.

Another significant British paper, this time by T. Nonweiler of the Department of Aeronautical Engineering, Queen's University, Belfast, took up the question of the motion of an earth-satellite on re-entry to the atmosphere. Equations were derived governing the final descent of a satellite which had been describing a large number of elliptical orbits. The paper considered atmospheric retardation and the effects of frictional heating on satellites of various mass and surface area.

Mr. R. E. Roberson, Autonetics Division, North American Aviation, took as his theme *General Guidance and Control Concepts for Satellites and Space-Vehicles*. His paper was a general discussion of the relation of guidance and control to astronautics,

Prof. S. F. Singer (U.S.A.) delivering his paper on cosmic radiation and its possible effect on manned satellites.

emphasizing concepts and conceptual problems. Existing guidance concepts, he said, were inadequate for most future astronautical missions and this area deserved early and extensive investigation.

The arrival of more sophisticated artificial satellites was foreshadowed by Dr. Fred L. Whipple, who considered the technical feasibility of placing an astronomical telescope in a satellite orbit around the earth. The study was performed by members of the Smithsonian Astrophysical Observatory and the Harvard College Observatory, and led to the conclusion that experiments of this kind could be realized fairly soon. The main advantage of placing an astronomical telescope in a satellite orbit, Dr. Whipple said, was that it opened the far ultra-violet spectrum much below 3000A for the instrument. It was believed that ultimately, by the use of grazing incidence reflection, a telescope could function in the short X-ray region of approximately 10A.

The scheme outlined by Prof. Whipple provides for an electronic scanning device and a transmitter for sending the information to the ground; also a command-receiver which controls the stabilizing, focussing and orientation equipment.

Impulsive Mid-course Correction of a Lunar Shot was the title of a paper by M. W. Hunter, W. B. Klemperer and R. J. Gunkel of the Douglas Aircraft Company, who were concerned with enhancing the accuracy of Lunar probes by the expedient of a thrust impulse applied somewhere along the transit path. Literally hundreds of similar investigations have been made by Douglas over the past few years in support of the Thor-Able project and similar schemes for space-research.

Looking further afield, R. P. Haviland, of G.E.C.'s Missile and Ordnance Systems Department, took as his subject *Consideration of the Solar Probe*. It had recently become apparent, he said, that the Earth was immersed in the solar atmosphere. In the vicinity of the Earth this atmosphere consisted largely of ionized hydrogen of a density of about 400 particles/c.c. A solar probe offered the opportunity for investigating the solar atmosphere directly and for conducting a number of other investigations of the Sun and the various environmental factors associated with it. Assuming that a five-stage rocket was the limit of practical design, it was found that a 250,000 lb take-off weight was required to place a 50 lb payload at the distance of Mercury. A reasonable approach would be to use liquid-propellant units for the first two stages, and solid propellants for the last three. All manœuvring would be accomplished in the early stages of the flight.

A possible shape for the probe was a cone with the base towards the Sun, and with the cone angle so chosen that the sides were always shadowed. Over the range of interest, from 30 to 100 Sun-radii, it was possible to secure a body temperature between about 150 deg and 1,000 deg K. Over this range the allowable temperature limit is determined more by components for instrumentation than by structural factors. A stabilization sensing system could be operated by the Sun's radiation. Assuming that telemetry was only required until the probe was first eclipsed by the Sun, a total distance of about 200 million km must be bridged, for which a frequency of 1,000 Mc/s was most suitable. A narrow-band C.W. system, such as Microlock, was proposed, with a radiating power of 2kW. Intermittent transmission of data would be employed to reduce the power requirements. Haviland suggested that investigations of the kind envisaged here would form a sound basis for the extension of the Geophysical Year.

Signing-in for the Space Congress. Nearest the table, r. to l., are D. E. Koelle (W. Germany), Dr. W. von Braun (U.S.A.), K. W. Gatland (U.K.) with Mrs. Gatland, and Gordon T. Walker (U.K.).

FARNBOROUGH WEEK

The Most Memorable S.B.A.C. Display Yet

POSITIVELY NO DECEPTION, ladies and gentlemen! The Wessex on your left is UPSIDE DOWN! So roll up, roll up. The fairground is on your right.

IN describing the opening stages of the Nineteenth S.B.A.C. Display last week we said that as a spectacle it was "the most dramatic of all Farnboroughs; as a demonstration the most significant." The subsequent days of flying more than justified that verdict. All the aircraft were definite "runners" in the commercial race; there was a record number of 362 stands in the indoor exhibition tent (itself the largest canvas-covered building in the world); there were missiles of every sort—including, on the last day, the Saunders-Roe Black Knight—all of them exportable to "approved" clients. The flying programme had everything: technical interest, variety, superb piloting and spectacle. On the ground, too, the standard of showmanship was notably high.

Considering the so-called summer which had preceded the show week the weather was surprisingly kind. Attendance was at record level, with 7,300 guests from abroad during the trade days and 23,000 visitors on the first public day. The lower-priced days on Saturday and Sunday drew 105,000 and 110,000 people respectively—those on Saturday bringing a traffic policeman's nightmare of 8,000 cars.

A number of firm orders were placed during the show, notably (as recorded on page 432) that for a Rotodyne for Okanagan; and finally Mr. A. C. Burke, president of the S.B.A.C., was able to say that he could look forward confidently to further well-stocked displays—as far ahead as 1961.

The organizers lived up to their reputation; they were even asked by some American guests how so much flying was safely packed into so close a schedule. What has been aptly described as the forbidden fruit of sonic booms was savoured by many on Tuesday, Saturday and Sunday. The first sample was apparently planted by an "outsider," the second was attributed to the Royal Navy's Scimitars, although the pilots had excellent alibis; a third was allegedly caused by the English Electric Lightning during a tearing low-level pass. Some windows in the control tower were broken on this occasion.

The day-by-day report which follows gives an account of the hour-by-hour progress and highlights of the show.

* * *

Tuesday, September 2, first of the trade days, brought a heavy sprinkling of V.I.P.s to Farnborough during the dull but warm afternoon. They included Earl Mountbatten, ex-King Leopold of the Belgians, Mr. Aubrey Jones, Mr. Duncan Sandys, Mr. Harold Watkinson and Air Chief Marshal Sir Dermot Boyle. While visitors at this level were being entertained at the president's tent or were examining the second NA.39 in one of the hangars, the rank and file of the S.B.A.C. guests began to appraise the aircraft in the static park and the products on show in the exhibition tent.

The equipment park, mid-way between tent and aircraft, was also worth their attention. For here was assembled a glorious collection of vehicles, improbably shaped and brightly coloured. Sprinkler/sweeper/collectors for airport runway cleansing, for example. Electro-hydraulically adjustable Autostairs, motorized overwing hydrant dispensers, fully integrated electrical ground supply trolleys, cooling trolleys, heater trolleys and the familiar crash and fire tenders. Mobile working platforms and missile carriers—and a tall, red crane which, a notice told us, had placed in position the majority of heavy exhibits in the exhibition halls and the outdoor equipment park. "Applications for its assistance in dismantling," the notice concluded in a bland and helpful way, "should be directed to the S.B.A.C. site office."

Tuesday's flying began with an unusually flat take-off by the Scorpion Canberra flown by Tom Lampitt, whose rocket firing control failed to function. The clouds had broken up nicely by this time and it was clearly going to be a scorcher of an afternoon. The Canberra T.11 pointed its pencil-sharpened nose to the sky, the Tyne (Ambassador) flowed quietly by, and the first day's display for the industry's customers was under way.

Type by type the programme continued. The Navy's seven Sea Hawks and six Scimitars repeated Monday's extremely ship-

The captivating moment when the great Fairey Rotodyne lights up its tip-jets, with attendant haloes of kerosine vapour.

shape display, with Lt. John Leeson substituting for Lt. Dimmock, who had ejected and broken an ankle the previous day. The understudy lost position during one loop and pulled away, to rejoin later for the landing. He had nevertheless done very well in the circumstances, pointed out Capt. Stovin-Bradford, publicity officer for the Fleet Air Arm at Farnborough: this pilot had not flown since the previous Thursday and had been married that Saturday.

The sight of 22 Hunters, all in a broad vic and all in a loop, could not fail to impress, and the R.A.F. were, if anything, in better form than on Monday. By this time the sun was really cooking the company enclosures (where managing directors had already moved back into the rearmost shade), but cumulus clouds were getting in the way of the formation aerobatics.

A muffled, multiple sonic bang was heard, but not identified, during the later demonstration by the Hawker company's three Hunters. Half-loops and rolls off the top by Victor and Vulcan in simulated LABS manœuvres followed (we still needed some time to get used to this idea). The first 1958 Farnborough displays by the Blackburn NA.39 and English Electric P.1B Lightning rounded off the programme. Sailor Parker's press-to-transmit button had jammed on while the NA.39 had been in the circuit the previous day, and the Lightning had had starter trouble. No snags today though, with Parker bringing across the Blackburn machine, white-bellied and with bright roundel-blue upperworks, in three impressive runs; and Beamont giving the polished, tight and brisk P.1-type of display for which he is renowned. As a tailpiece to the afternoon's flying programme, the Scorpion Canberra flew again, this time with the Scorpion rocket motor in diamond-studded action.

"Wet Wednesday" is an apt summing-up of the second of the trade days. The forecast weather—"Rather cloudy, with risk of thundery showers towards the end of the flying period"—was pure understatement, and a steady drizzle began just after 1 p.m. While the optimistic few sat down, hoisted umbrellas and waited for the flying display, the majority settled for a close look inside the exhibition tent at the top of the hill.

Here, as happens each year, there was more to see than ever before. Within the standard dimensions allowed, countless individual differences between the various stands were apparent. There were the familiar aircraft models, with large glossy ones on the large glossy stands; sections of actual aircraft; and components and accessories in incredible diversity. A king-size spin dryer with a wobbling top that was a vibration generator; six dummy heads (wearing lightweight headsets) laid in a row; soft (albeit high-density) airline seats which you could try for size; and complicated mechanisms which went kerchuck, kerchuck, kerchuck . . .

Many were the techniques of display. Some units were shown operating while immersed in tanks of tropical fish. An oil company showed a flying saucer floating across the surface of a lunar landscape; one company was overlooked by a large bull's head and accepted the risk of its decoration by neighbouring exhibitors; and small radar scanners clicked rapidly from side to side as if watching a game on the centre court at Wimbledon. There was also a ring of orange lights which, it transpired, was not a display gimmick but something to do with a commutated antenna direction finder.

Through the midst of the serious industry shop-talk around the many stands, the industry's staple refreshment dispenser, the tea trolley, toured up and down the aisles. "Tea, sir?" promised to become well known as one of the street-cries of old Farnborough. And indeed flower girls were there, too, not selling flowers but carrying watering cans and revitalizing the displays of plants which, like many of the guests, were feeling the heat.

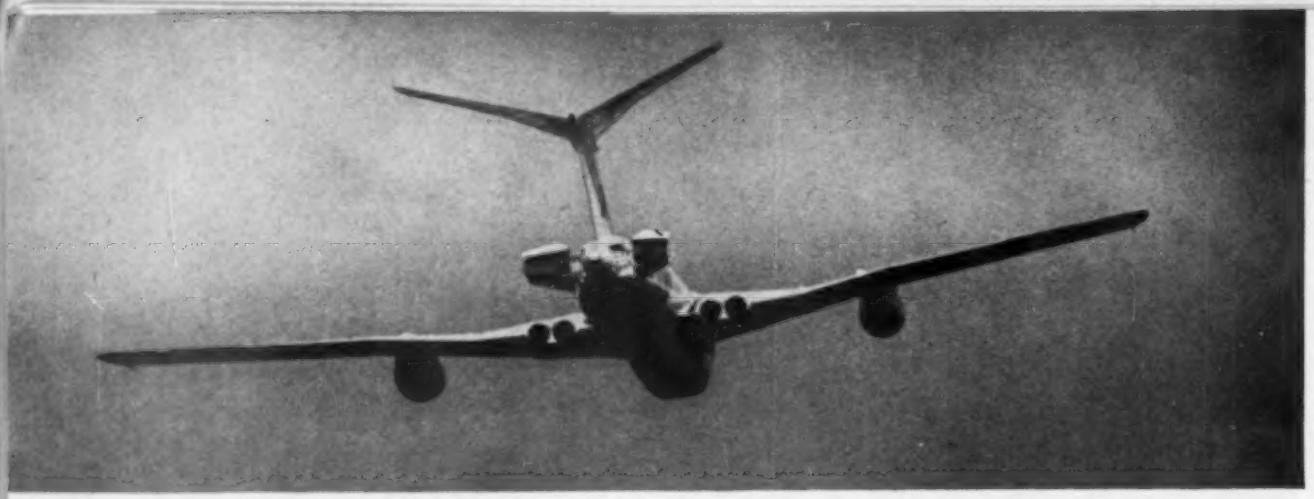
ILLUSTRATED MAINLY WITH "FLIGHT" PHOTOGRAPHS

". . . General conditions, in fact, are thoroughly bad. . ." This was the voice of Oliver Stewart concluding his 2 p.m. summary of the weather. This was no news to the plastic-coated souls outside—nor to the tropical-suited gentleman seated on a chair on the grass who depended for protection from the rain on a copy of *The Times Aviation Supplement*. Across on the other side of the main runway 800 Squadron's Sea Hawks sheltered beneath their own folded wings.

The flying programme began on time and the early items were not unduly affected by the steady drizzle or the low visibility. As the Bristol 192 was swirling on one engine, the Westminster seemed to crawl out rather than taxi in preparation for its own appearance. Was it a prehistoric monster with two bulging close-set eyes, or a huge fish with head and tail and little else?

The Royal Navy's show was slightly limited today, with a solo Scimitar flown by Lt-Cdr. Geoffrey Higgs replacing the six-man formation. The Hawks were able to take advantage of a temporarily high cloudbase to carry out their normal repertoire. As for the R.A.F. participation, cloudbase at Odiham, where the

A Gordon Horner impression of the Bristol Bloodhound demonstration by personnel from North Coates—the first SAGW station.



FARNBOROUGH WEEK . . .

Hunters were based, was only 300ft, in spite of which five of the black Hunters of 111 Squadron came over to make the most of patchy weather. The formation's initial loop was completed in cloud and the remainder of the display comprised banked flypasts in changing formations during a series of wide circuits. The only other R.A.F. machines to take part were the Jet Provosts of C.F.S.

The limited programme, including flypasts in heavy rain by the Javelin and the Hunter trio, continued. From the upper caravans spectators gazed out over the sodden blue-and-white canopies of the enclosures below towards the main runway, where the Sea Vixen kicked up a wide grey spray as it accelerated on take-off. A run by the NA.39, a pass behind the stands by the Sea Vixen, and two runs by the Vulcan with the stand-off bomb preceded the appearance of the Victor, which was to be the final aircraft. To help compensate for the appalling weather, Spud Murphy swung the wing-tanked Victor in a well-barrelled roll—for the first time at the show—by way of finale.

A comparative study in dive brakes: the Handley Page Victor B.1 strategic bomber (top) and the Blackburn NA.39 strike aircraft.

Left, a comparative study in missile-armed all-weather fighters: top to bottom, the English Electric Lightning F.1 (inverted during the delivery flight to Farnborough); the Gloster Javelin FAW.8; and the de Havilland Sea Vixen FAW.1.

Thursday was a grey and misty morning and the flying prospects did not seem good. Outside the exhibition tent there was a fair-sized audience for the missile demonstrations and, on the principle that after three days' practice the crews should be pretty good, *Flight* climbed the hill to watch the Army loading and unloading its Thunderbird. This it did efficiently with much running, wheel-turning, nut-screwing, sliding, plugging in and an amount of brute force. One of the crew, we noticed, had a heavily bandaged hand. Star performer was the N.C.O. in charge, especially for his "traverse left . . . 'alt," " Traverse right . . . 'alt." All these things the Thunderbird seemed to do obediently enough, but the smart drill of the boys in khaki was clearly hard work. They were well pleased to hear the final bark: "Deee . . . tachment, cherghgh . . . fall OUT."

Meanwhile, at the foot of the hill, the well-stocked newsagent's stall was playing its part in the education of Britain's youth by selling "rocket age models" in the form of toy Thunderbird and Bloodhound missiles.

At the 1.30 p.m. briefing in the pilots' tent, G/C. Hanafin announced that the display would start with radar circuits in force. This would mean straight flypasts at specified heights. The met. situation was complex: the low stratus might lift and visibility might improve during the afternoon, but there was the possibility of cu-nim development. The briefing was quickly over. As Mr. Pearson, senior air traffic controller, called a time-check, "1340 in 20 seconds," Westland pilot Slim Sear returned to the attack on his lunchtime lobster and Ranald Porteous of Auster settled down again with a paperback entitled *Look Down in Mercy*.

Immediately after this talk of radar circuits the pilots were surprised to find they needed their sunglasses on leaving the tent. The haze was causing a great deal of sun glare and the visibility along the runway was not good. Across to the left of the pilots' tent was the R.A.E. Director's enclosure; in front there were the red crossbar lights of the runway threshold; while to the left by the control tower were the stilted red-and-white Jet Provosts and the nine staring roundels of the immaculate line of Hawks.

"Lining-up for lining-up for take-off take-off" the opening

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FARNBOROUGH WEEK . . .

announcement comes at us from two directions. There are some liquid-blue patches among the thick cloud and haze which cover most of the sky. We view the take-off of the Canberra T.11 from the rear, the Gannet AEW.3 follows, and the show is on. During the early part of the helicopters' display, the Fairey Ultra-Light is carried past the pilots' tent on its lorry, with a yellow-jacketed crewman crouching on each side, on course for the runway. The P.531 and the two Skeeters take their bow and retire and the Ultra-Light—and lorry—are on stage. Then the Westlands, which seem even more impressive in their wingovers when you are almost underneath them. Derek Colvin in the Whirlwind shows how easy a LABS delivery of a homing torpedo could be.

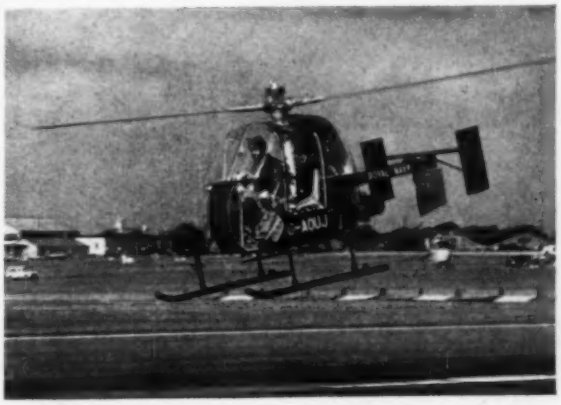
Shortly after the Hawks have taken off, an abbreviated Scimitar formation flashes over higher than usual from the west, and we later learn that there was a tricky near-miss between the two Naval formations in the haze to the north-west of the airfield. In the meantime the Navy continues with its show and each manœuvre is closely watched (as are those of every Farnborough performer) by those remaining in the pilots' tent enclosure. The Comet 4 is not appearing today among the Group B commercial aircraft, otherwise the display follows the planned programme.

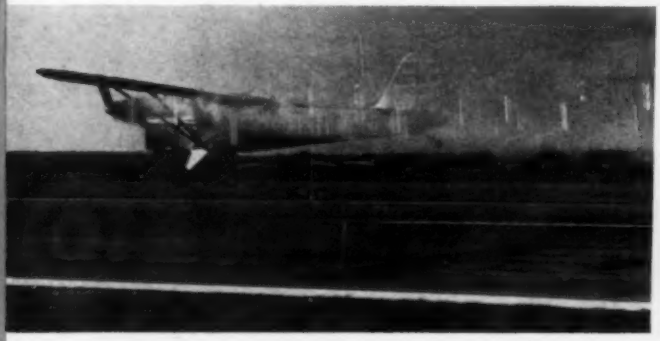
Back to full strength again, the 22-aircraft Hunter formation gives another splendid display, the Hunters cutting across the sun's rays edging over a cloud to give a subtle, flickering shadow pattern. The Jet Provosts come past on their landing approach, and we realize just how closely grouped they are.

Gnats, Javelin, Hunters and Sea Vixen—all, it seems, try to deafen us. LABS manœuvres and rolls by Victor and Vulcan, and then the NA.39, folding in its rear-fuselage airbrakes on one run as it approaches. The Lightning taxies out: Roland Beamont is watching from the tent and so the pilot must be S/L. James Dell, R.A.F. project officer at Warton. Although the Tyne Ambassador and the Scorpion Canberra are also fitted into this final phase of the flying programme, it is Dell who undoubtedly steals the show, with fast rolling runs and what is probably the tightest turn at speed that has been seen at the show this year. "To Bea or not to Bea" may have been the question, but Dell has shown himself well able to display the Lightning in the best Beamont tradition.

The quality of this particular piece of flying at the end of the last trade day at Farnborough emphasized an ironic aspect of the organization of the show, which was criticized repeatedly during the week. This was that the names of pilots (with the exception of some of the Service participants) were not announced during the flying display. Another point of criticism of the commentary was that no descriptive details were given of any of the aircraft taking part. Before an audience of designers, manufacturers, operators and Service and Government personnel from all over the world, it seems illogical (to put it mildly) that the men responsible for the demonstration flying should not be named, and that no details of their aircraft—particularly the new machines—should be given. This, however, was official policy, as was the full commentary given on the public days.

Following a demonstration of the Fairey Rotodyne at White Waltham on Thursday morning, the first order for this aircraft—one machine for the Okanagan Helicopter Group of Vancouver—was announced by the Fairey Aviation Company later that day. A





The light brigade: (right) the Fairey Ultra-Light helicopter; (below) the Auster Alpha sprayer, and the D.H. Agricultural Chipmunk.

FARNBOROUGH WEEK . . .

Jet Provost flown by Hunting pilot John Burns, which had been exhibited in the static aircraft park at Farnborough, made an emergency landing and burst into flames in a field near Taplow, Bucks, on Thursday evening. The pilot was unhurt.

Friday. There are several ways of looking at the S.B.A.C. Display—e.g., from the spectators', the pilots' and the controllers' points of view. Friday seemed an admirable day for trying out the second, especially as a mist-laden atmosphere and approaching thunderstorm made it not the easiest of flying days; and in the Hunting President, with Barry Radley at the controls, the experience proved both interesting and instructive.

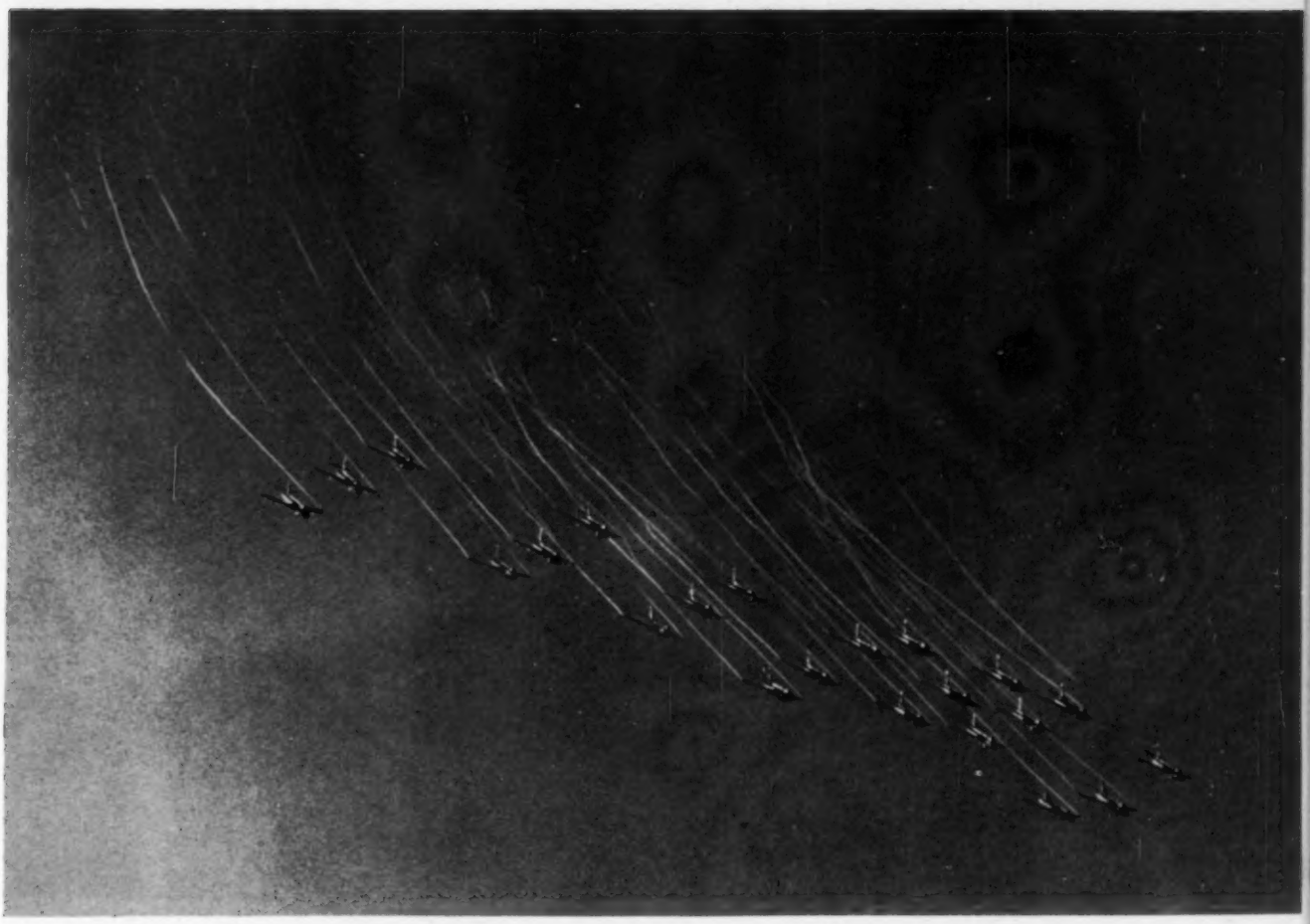
Not the least fascinating part was listening-in (while waiting in the wings, so to speak) to the pilots performing previously. Thus the junior helicopter school (Skeeters and P.531) came over with the martial discipline of an aerobatic team: "descending in turn . . . stand by to break"; and the playful Ultra-Light was sternly told: "one minute to go"—shortly afterwards coming round the peri-track on its lorry, like a baby being put to bed. Then the bigger boys, the Westlands, put on their agile show with Bradley's inversions looking even more astonishing when viewed through the top of the President's cockpit; and when the Sea Hawks were airborne Lt-Cdr. Perrett's instructions came clearly over the R/T: "We'll smoke on the top of this one only . . . are you going to roll through my loop? (this to the Scimitars) . . . somebody's smoking—a red one, on the left" (someone was having trouble with his smoke).

As we taxied out at 1535 behind the Twin Pioneer we heard the Sea Hawks' final instructions on circuit: "tightening up this turn a bit . . . half flap, go . . . wheel check." The four Scimitars rushed low over the airfield from the Laffan's Plain end, then: "President, line up . . . President, roger . . . President, clear for take-off." With the Twin Pioneer rolling down the left of the runway we rolled down the right, getting some of his wash as we gathered speed; at just under 60 kt and at 1542 we were airborne and turning towards Aldershot. "President, tight circuit, please." Radley took off his sun-glasses as we moved into the misty haze, feathered the port Leonides and put the nose down in a diving turn towards the runway. At nought feet and 185 kt we rushed along it, then up and over to the left in a 90 deg climbing turn rising to 300ft. At 500ft the port engine was re-started; we could see the Comet doing its low run over the airfield. "President turning base leg . . . President, finals." A short landing, at 1546, exactly four minutes after we took off; a fast roll up the runway before turning down the taxi-track called Vampire Way; past the Vulcans and their ground crews round the tea-wagon; up to the Gannet AEW.3 with Continental's Viscount drawing in beside us; then back to the pilot's tent—another Farnborough day over for Barry Radley.

From then on, it was a race with the weather, which improved for the splendid R.A.F. show, then darkened so much that lights could be seen shining inside the Rotodyne. Yet, thanks to Control and the pilots' skill, everything went off as planned, including the R.A.F. Valiant's dramatic arrival from Malta just after an R.A.F. Vulcan took off for Canada—though the F.D.2 lost its brake parachute on landing and gave everyone some anxious moments as it disappeared far down the runway into the haze. Only the Lightning was missing, still grounded—though there was plenty of natural lightning when the storm broke as soon as flying was over.

Saturday. Dominating the airfield, the control tower at Farnborough supplies a good view of all flying, apart from aircraft directly overhead or beyond the famous black sheds. But the fascination of watching the display from there lies partly in the fact that the controllers do not need to see the aircraft; they are in touch by R/T and can see them on the radar screens. In addition, one realizes how skilfully this display is organized; for even on a day such as this—when weather was all it should be and radar almost a luxury—there was no slackening of routine for the brisk entertainment of 105,000 spectators.

On the balcony of the tower, keeping a general eye on things, were G/C. D. P. Hanafin, who as O.C. Experimental Dept, is in charge of flying at the display; Mr. K. I. ("Mac") Pearson, senior air traffic control officer; and Cdr. K. R. Hickson, R.N., who fills the post of W/C. Flying. In Control were Mr. L. Vass and Mr. B. Madelin, both ex-R.A.F. navigators; and one's impression was of an unflurried confidence in handling the aircraft, with a strict eye kept on performance times, especially prior to the big R.A.F. participation. Mr. Vass hardly raised his voice over the R/T; occasionally he got up from the control desk to glance at an aircraft on the approach; as each took off he kept a stop-watch check on its airborne time. Mr. Madelin carefully recorded these times against the scheduled ones on slips of pink card on metal plates. Occasionally a 'phone rang (with a buzz, not a tinkle); the sunshine glittered on the rotor blades on the handsome 192; there was a strong smell of paraffin as the nine Sea Hawks—the first time so many have done a formation take-off and landing at Farnborough—taxied past with their wings folded; a pleasant perfume



Three contrasting Farnborough studies, each with its own appeal. On the left, the Blackburn NA.39 pulling up from a slow flypast. Above, the twenty-two Hunters of No. 111 Squadron, R.A.F., coming out of a loop. They are not—repeat not—using smoke; the white streamers are condensation trails from their wing-tips. Another assurance is necessary in respect of the picture below, showing the probe-equipped Victor B.1: the portion of the aircraft seen is the portion that filled the negative.

A new angle on the Blackburn NA.39, and, at right, a new one on the Handley Page Victor B.1 (inverted during a roll last Sunday). It was announced at Farnborough that the tailplane of the NA.39 is "blown" as well as the wing.

(Below) "'Neath the shelter of the old Comet 3"—a Gordon Horner impression, dated September 3—"wet Wednesday."

FARNBOROUGH WEEK . . .

drifted up past the tower when the agricultural Chipmunk and the Auster Alpha had completed their demonstrations; aircraft of the same company co-ordinated their displays with the help of control, for example, Peter Twiss in the F.D.2 was kept informed of the whereabouts of the Rotodyne—"just west of airfield . . . starting first run now"—so as to judge his own display accordingly; the Lightning re-appeared after its temporary grounding; and there were two (unscheduled) sonic booms.

Downstairs, in the cool air-conditioned radar control room, it was fascinating to watch the oncoming R.A.F. Hunters and Javelins making their run-in from 43 miles out and to hear the instructions passed to them by "The Whip"—the Meteor which acts as whipper-in. Thus, "Black Leader from Whip: you'll have to close in a bit more . . . Move up a bit, Pink Leader." Then, from Black Leader: "Speed about 370 kt, one minute to go . . . now hold it tight, I'm just crossing over." On the screen, the thick line of yellow dots moved over the airfield boundary as we heard the magnificent combined roar of Sapphires and Avons. This R.A.F. fly-past is all over in a few seconds, and the Farnborough public may give it no more than a passing glance. But a visit to the control tower brings home forcibly the amount of organization behind it and the whole display; and the safeguards which are present (both human and mechanical) to ensure that everything goes off as planned.

Sunday. Crystal-clear visibility beneath brilliant sun, but rags of wet grey cloud made positioning critical for the vertical evolutions during the Sunday afternoon. Fortunately the clear spaces were well "controlled" by a stiff breeze and allowed virtually the full gamut of Hunter, Sea Hawk and V-bomber manœuvres to be completed. Only the 16-Hunter roll was omitted.

Having appeared at both Farnborough and in an equivalent display at Toronto, Canada, on Friday, the No. 101 Sqn. Vulcan, now flown by F/L. Green, wended its way back to Farnborough at a cool 619 m.p.h., covering 3,600 miles in 5 hr 47 min. Its progress was regularly reported to the crowd over the address system, though the reading of the official message it bore was obliterated by Jet Provost noise. A successful first firing of Black Knight in Australia was also publicly reported.

The four C.F.S. Hunting Jet Provosts making smoke.

The display proper opened with a grand drive-past by the Farnborough assembly of thirty emergency vehicles of all types, followed by a Naval Whirlwind on rescue duty. And when these had taken their well-earned bow and departed to their various stations, the airborne show swung into action with the first circus, heralded by a sizzling Lampitt-driven Scorpion Canberra *pas de feux*. In due course this was followed by several *pas de vapeur* when the individual Hunters and the six Scimitars wrapped themselves in vapour shrouds as if hiding from the dreaded sound barrier. But ballet was more effectively imitated by the helicopters, though they would have none of the vapour *tutus* of their flat-out brethren.

The Royal Navy succeeded in perfectly timing the interlocking aerobatics of Sea Hawks and Scimitars; Treble One were in terrific form with two loops of the 22-man team. Surely we will never become quite accustomed to seeing V-bomber aerobatics. The two Vulcans and the Victor gave full-blown aerobatic performances, seemingly quite undisturbed by turbulence and cloud patches. S/L. Dell, in the Lightning, must have hiccoughed, for he exceeded Mach 1 at about 50ft and broke several windows in the control tower.

The proceedings were concluded by the Bristol 192; and when all was over there remained only a sea of waiting cars and skittering litter, green grass trodden brown, and a lurid sunset.

Credit line: The Hunters which brought up the strength of No. 111 Squadron to 22 aircraft, for the history-making formation loops, were provided—with pilots and reserves—by Nos. 1, 2, 19, 56, 92 Squadrons, the Central Fighter Establishment and No. 229 O.C.U.

H.T.P.

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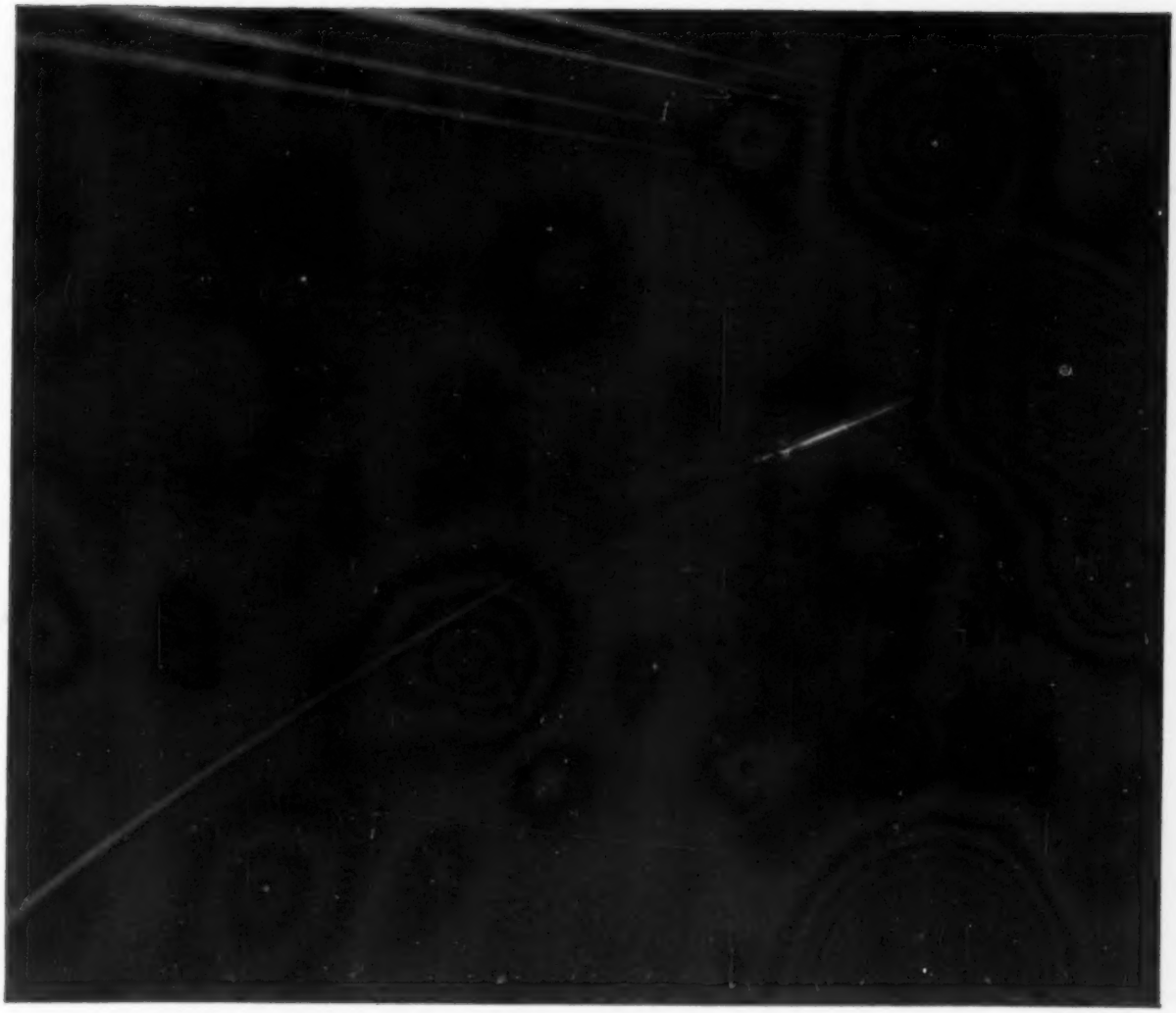

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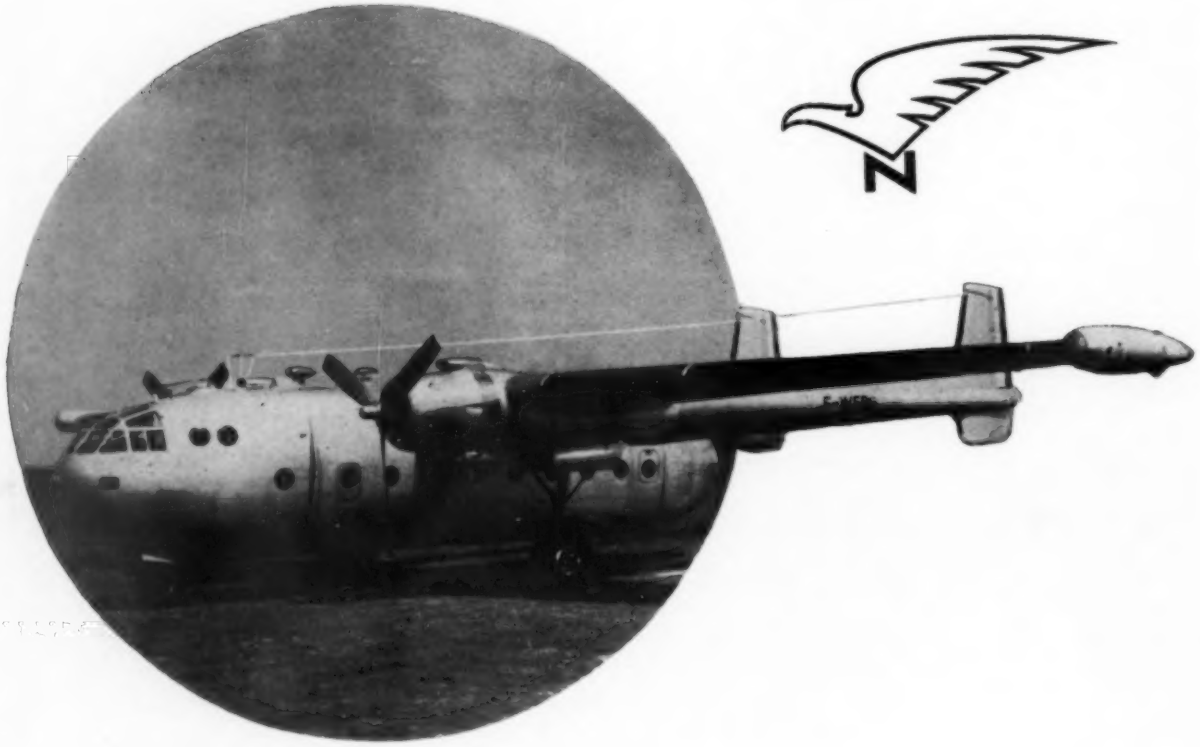

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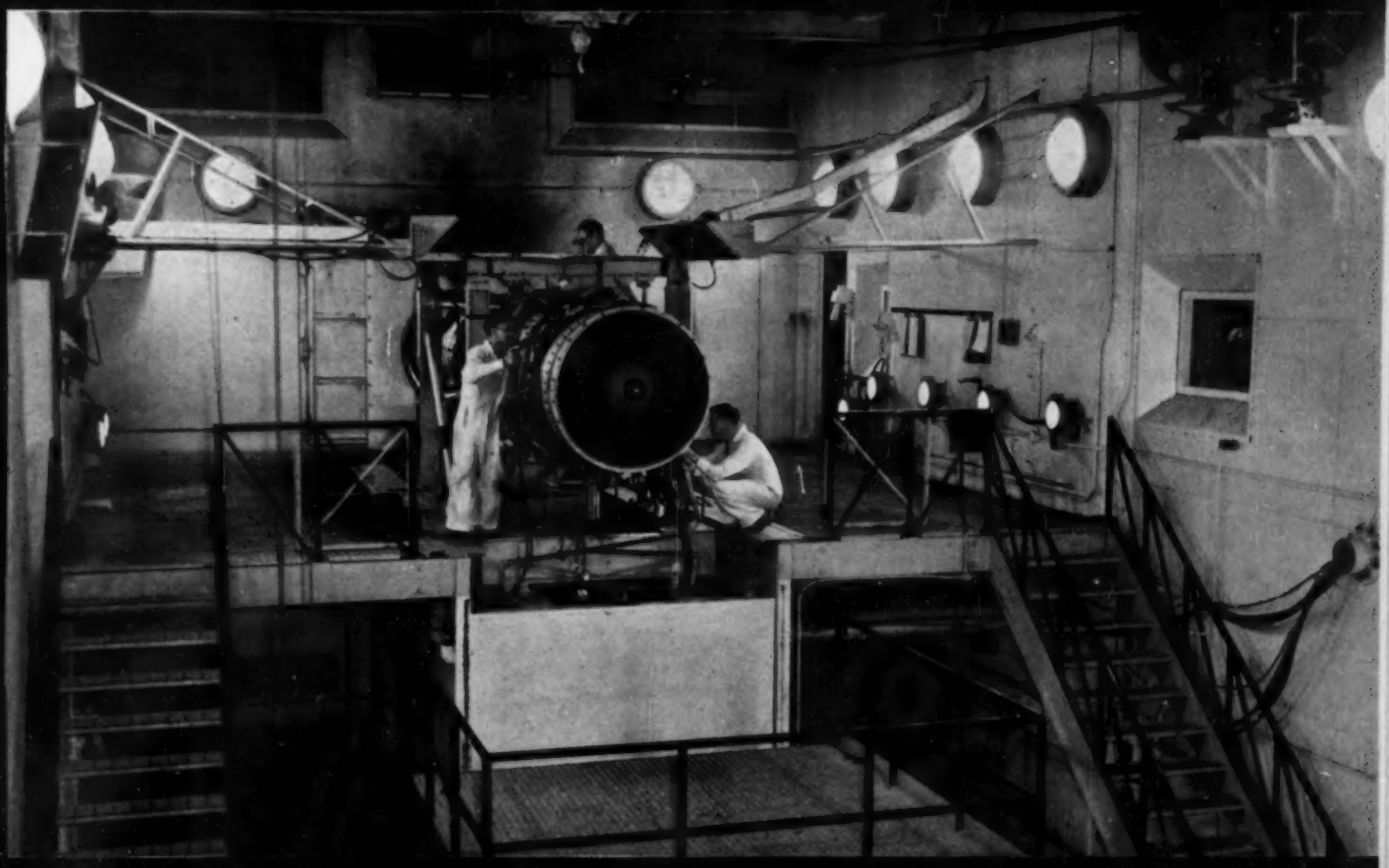

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IROQUOIS development engines have completed over 5,000 hours of bench running in these test cells at Malton and in flight tests.

Over 100 hours were accumulated during a recent series of test runs at the NACA Lewis Flight Propulsion laboratory, Cleveland, Ohio.

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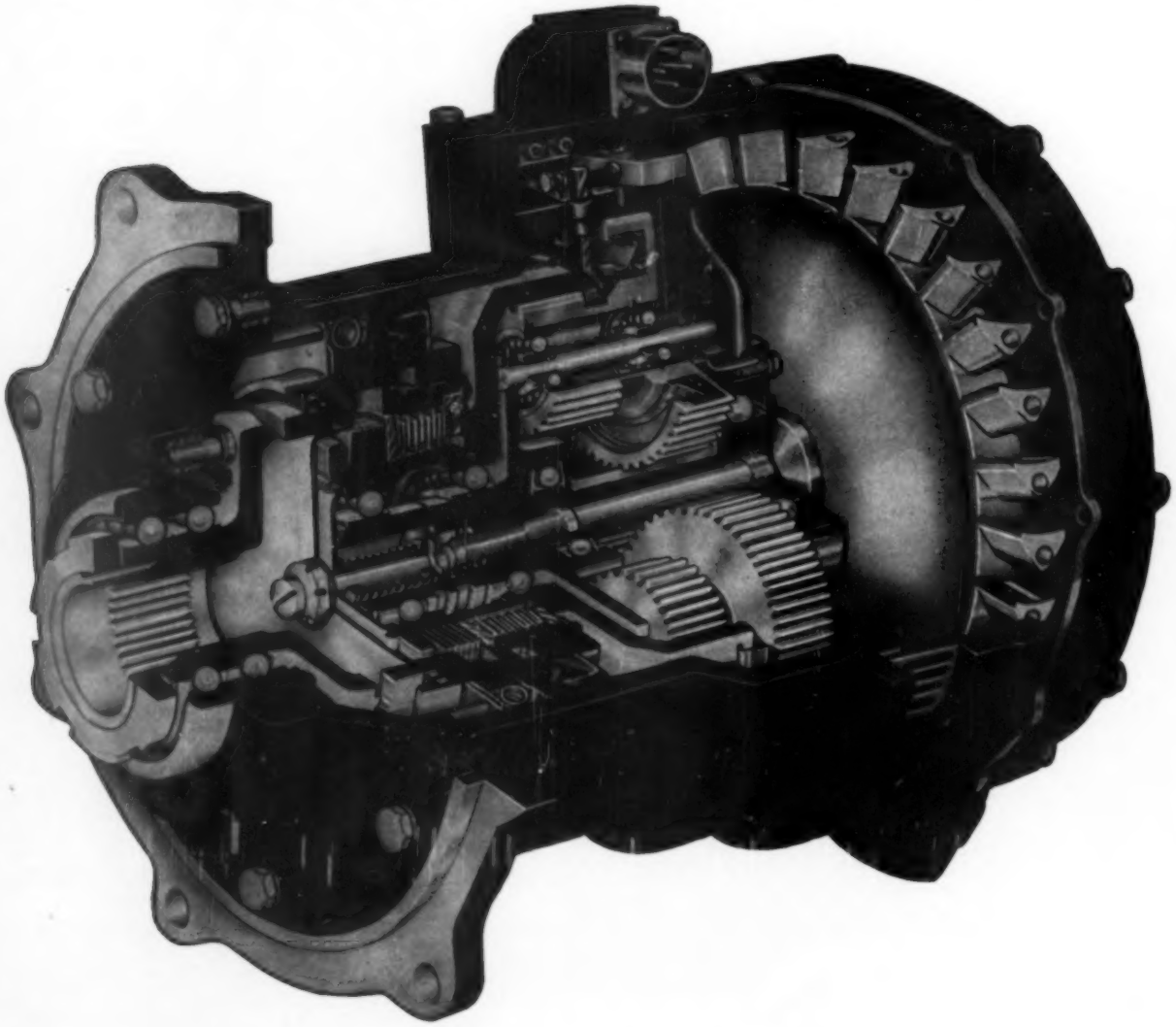

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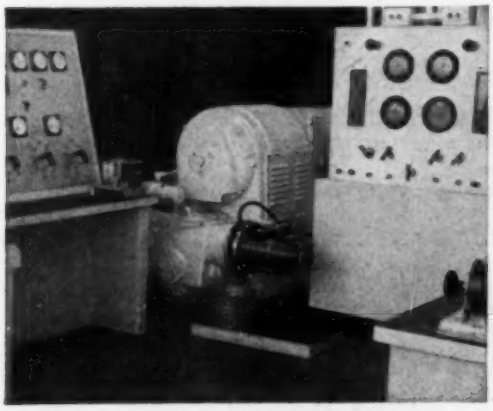

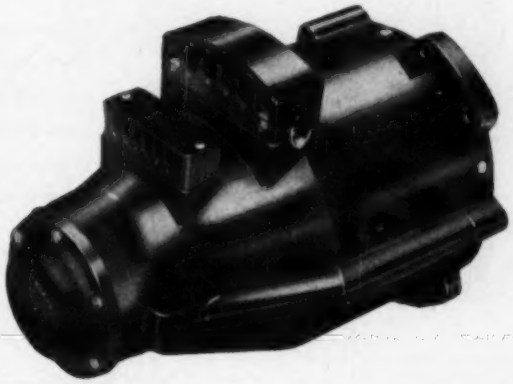

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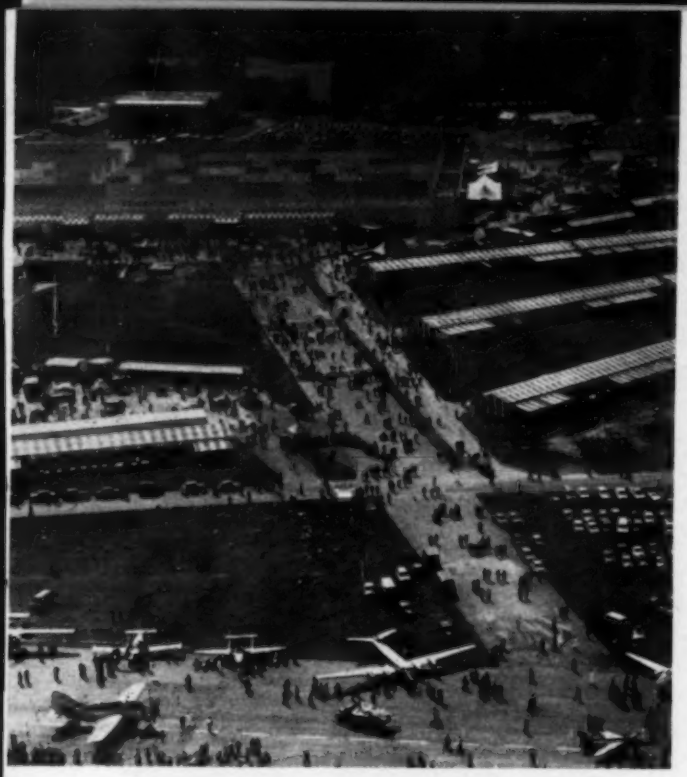
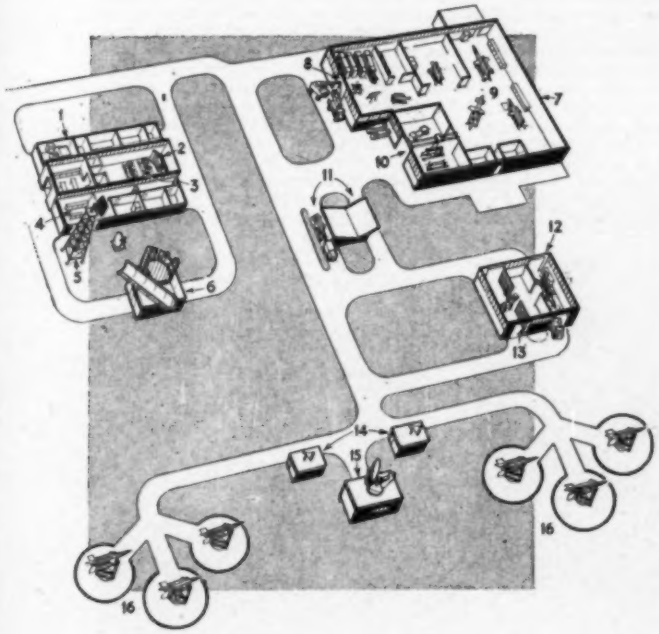


On the Ground

Dynamic Developments Seen at the Static Show

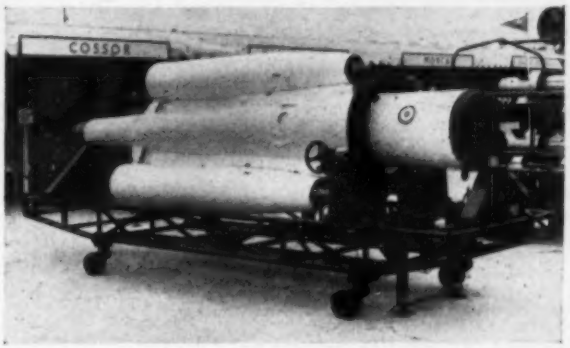
1 Control building
2 Operational display on glass wall
3 Sixteen 'scope operators
4 Storage racks
5 Radio-link tower
6 Tactical radar
7 Missile servicing shop
8 Crated-missile receiving section
9 Basic assembly of wings, guidance and warhead
10 Loading on to transporter
11 Kerosine pressure-fuelling
12 Arming shed
13 Boost motors on wall racks (fork-lift handling)
14 Plant buildings
15 Target-illuminating radar
16 Missiles in launchers



Weapons

AS noted in our issue of August 29, the first generation of British guided weapons consists solely of systems designed to destroy manned aeroplanes. These still represent a major part of the effort, and anti-aircraft missiles, fired both from the surface and the air, completely dominated the missile picture at the 1958 S.B.A.C. Show. The four chief missiles in this category are: the Bloodhound, the R.A.F.'s surface-to-air weapon with an airframe by Bristol Aircraft, propulsion by Bristol Aero-Engines ramjets, and semi-active radar homing guidance by Ferranti; the Thunderbird, the Army's surface-to-air weapon (also being developed for the R.A.F.), the prime contractor for which is English Electric, with semi-active radar homing guidance by Marconi and propulsion by an I.C.I. solid sustainer (which in future versions of Thunderbird will doubtless have a very high specific impulse); the Seaslug, the ship-to-air missile of the Royal Navy, with an airframe by Armstrong Whitworth, control by G.E.C. and guidance by Sperry; and the Firestreak, the air-to-air missile of the R.A.F. and Royal Navy with the bulk of the work, including infra-red homing guidance, handled by de Havilland Propellers. The curtain of security surrounding these weapons was lifted but slightly this year, and the bulk of the new revelations concerned the non-flying portions of these weapon systems—as distinct from the missiles themselves—and their method of employment.

This year a great deal of the Bloodhound weapon system has, at least in so far as external appearance is concerned, been revealed for all the world to see. The standard surface-to-air missile of the R.A.F., and already being delivered in bulk to Fighter Command, Bloodhound has been designed and developed by the Guided Weapon Division at **Bristol Aircraft** in collaboration with Bristol Aero-Engines, Ferranti, B.T.H. and other companies (the

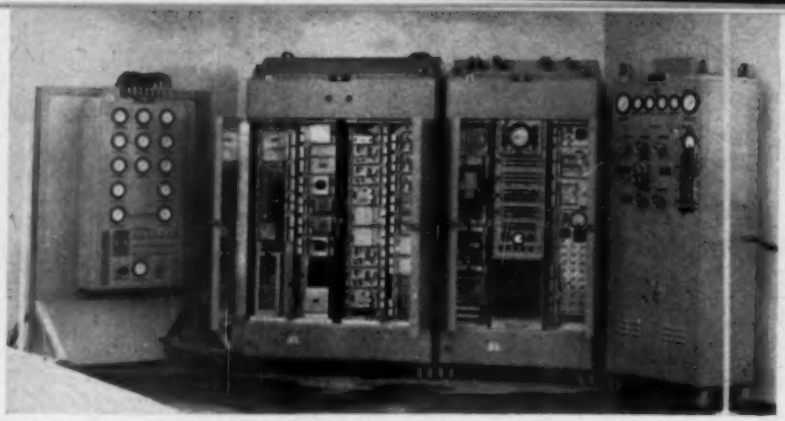


The Bloodhound weapon system is now in quantity production for the R.A.F. Above is the M.L. mainbody and assembled-missile rotary trolley, described overleaf. It is used in the section numbered 8 in the sketch on the left, which—although not drawn at Farnborough—reveals for the first time details of an R.A.F. Bloodhound site.

Bloodhound work-force is stated to exceed that applied to any other weapon in Europe). The choice of propulsion by twin ramjets and control by a monoplane moving wing were arrived at in order to provide a weapon with the maximum inbuilt development potential. It is claimed to be the longest-ranged missile in the Western world with semi-active radar homing, and strong hints have been dropped that future versions are already in the advanced development stage.

Bristol Aircraft make the airframe at their Cardiff factory and some notes on its construction appeared in our issue for September 13, 1957. Ferranti's contribution can be summed up as follows: the guidance and control systems; assembly of rounds up to a condition in which they are fit to be loaded on to their launchers; diagnosis and rectification of difficulties in components or complete missiles; fire-control necessary for target-selection, missile preparation and launching; and mobile equipment for the periodical testing of the electronic circuits of missiles on their launchers. Extreme care has been taken to minimize the routine servicing necessary to maintain the whole system at an advanced state of readiness. All portions have been made readily transportable; the radar and control units can be housed in vans, and although the zero-length launchers require a prepared base they can be quickly provided with a cross-country chassis.

At Farnborough Bristol announced their inability, on security grounds, to display a model of a Bloodhound installation with any greater detail or trueness to life than the rudimentary display seen last year. The R.A.F., however, have constructed a most



Notes on the progress of Seaslug, the Royal Navy's anti-aircraft weapon, appear below. On the left is one of a series of frames taken by the tip-mounted camera of a Firefly (which would have been destroyed if the round concerned had borne a warhead); on the right are the Sperry control-system test consoles, superficially similar to those produced by G.E.C. for checking the guidance system.

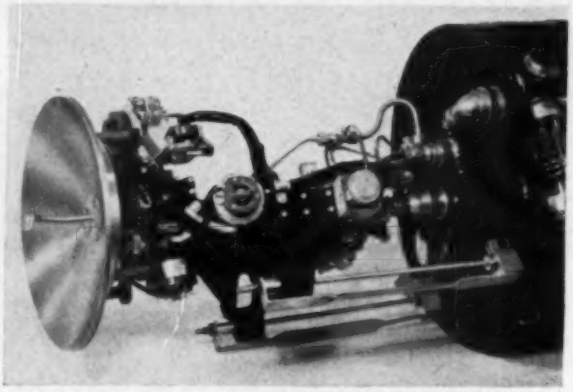
ON THE GROUND . . .

revealing model of a Bloodhound installation for the Radio Show at Earls Court, London, and our artist has sketched it for inclusion here. Points worth noting are the considerable size of the buildings, the employment of no fewer than sixteen operators to monitor the radar displays, the extensive use of fork-lift trucks and the storage of boost motors on wall racks. The complete system can be employed either to provide a barrier type of defence for an extended area or perimeter defence of a more compact locality. In either event, launchers would be disposed in groups known as Fire Units, similar to that depicted in the diagram. Normally each early-warning or tactical control radar would pass data to a number of Fire Units, the illuminating sets at the latter then locking-on and, by way of the control post, passing data to the missiles on the launchers. It is worth noting that the employment of semi-active homing enables a number of missiles to be guided simultaneously by the reflected signals from a single illuminating radar. The missiles are fired automatically as soon as the target comes within range. Almost all the operations involved—including the checking of missile serviceability—are automatic; the firing sequence can be interrupted for any given period at any time before the actual launching.

Much of the ancillary portion of the Bloodhound surface-to-air weapon system is produced by M.L. Aviation. The largest items, of course, are the launcher, its limber and loading trolley. A subsidiary item is the "mainbody and assembled missile stand" in which the centre section of the Bloodhound body, complete with twin Bristol Thor ramjets, is rotated for easy inspection and assembly. The vehicle is fabricated from steel tubes and is mounted on four small castors. One end can be elevated on a pair of vertical screw-jacks driven by gearing from a hand-wheel. The missile body is held in a pair of large hoops, the forward hoop being surrounded by a manually driven system which rotates the weapon about its longitudinal axis. A special extension-piece bolted to the rear of the body is located in rollers on the stand.

The external appearance of the **English Electric** Thunderbird weapon system has for some months been a known quantity. The first version of Thunderbird has now reached full production status, photographs having been published in our issue of August 8. This issue contained an article describing the complete weapon system and the method by which rounds are received, stored, assembled, tested and fired from an operational launcher. A mobile launcher was on display at Farnborough and its Army crew showed their proficiency at manning it. An unexpected exhibit on the company's interior stand was a cutaway Thunderbird control package, which surrounds the tube joining the solid sustainer charge to the propelling nozzle and actuates the four sharply tapered fins (see sketch opposite).

In previous years only early test rounds for Thunderbird have been seen, but a genuine Army missile was exhibited this year. Similarly, **Armstrong Whitworth** have previously only been able to display early configurations, whereas the Propulsion Test Vehicle seen this year has a configuration almost indistinguishable from that of the production weapon. Four large boosts, with conical noses, replace the four triple boosts previously seen (the latter having large wedge noses to provide an outward force ensuring immediate boost-separation at burn-out). Seaslug's configuration is extremely compact—a fact which stems largely from the forward mounting of the boosts, which thereby do not require stabilizing fins. A model of a hypothetical Seaslug-armed ship indicated that complete rounds will be stored below decks in special magazines, the warheads and boosts being installed. Powered feedways transport the weapon to the guidance and check-out rooms. The large and complex test equipment mounted therein was displayed at Farnborough. A photograph shows the check-out cabinets for the Sperry control system, points of interest being the cathode-ray tube, the continuous-trace recorder and the perforated chassis construction for many of the units.



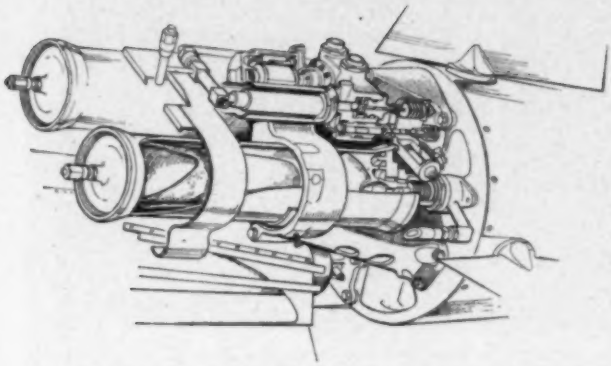
A close-up of the latest radar homing head by Elliott Brothers, fitted to the semi-active homing Short GPV research vehicle.

Similar cabinets are employed for the automatic checking of the G.E.C. guidance system. Accepted rounds are then attached to conveyors leading to a triple launcher mounted on the foredeck.

Undoubtedly all three of our first-generation weapons are extremely good, and fully competitive with their known contemporaries. After years of unproductive sweat and tears, nothing can be more thrilling to the team developing a missile than to achieve a strike on a target with an inert round (i.e., a test missile not fitted with a warhead). This year Bloodhound, Thunderbird and Seaslug have all demonstrated their ability to achieve consistently successful missions, and each has "splashed" a target by direct impact. This has been achieved not only with Fireflies flying straight and level at 10,000ft, but also with Meteors and elusive Jindiviks which can manœuvre at 600 m.p.h. at 50,000ft. (For the record, news was given last week of the performance of Seaslug during a recent test from H.M.S. *Girdle Ness*; of two consecutive rounds fired, the first demolished the target aircraft and the second struck the largest remaining piece of wreckage.)

One of the few operational missiles whose interior "hardware" has been publicly seen is the widely used Firestreak, by **D.H. Propellers**. Power packs, air bottle, alternators, rate gyro and other portions were all displayed at the 1957 Show. This year D.H. Propellers exhibited associated weapon-system equipment,

This is one of the two Microcell packages, each holding 24 two-inch rockets, which will be carried by the production Lightning fighter.



Displayed by the English Electric Group was a sectioned Thunderbird-type control drive, revealing a gas-pressurized hydraulic accumulator (compare with the CTV drawing, September 13, 1957, page 446).

including: the fire-control equipment, which includes a power unit, slaving unit and launching-sequence unit; the power supply, which energizes the missile before firing (it cannot yet be stated whether the gyros are driven pneumatically or electrically, but these must obviously be spinning before the weapon is released); and the heater pack, which provides conditioned air to warm the Firestreak while it is attached to the aircraft pylon (the infra-red seeker head, for example, must be maintained fairly close to the optimum temperature, and ice must also be prevented from forming over the glass nose of the missile).

A team from the R.A.F. G.W. development squadron demonstrated **Fairey Aviation's** Fireflash. While armourers tested and assembled the explosive portions, technicians built up the remainder. After proving the beam-riding guidance and control systems, the air bottle was charged and the explosive assembly attached by a simple screwed rack-and-pinion joint. Last week we recorded the appearance at Farnborough of two new versions of Fireflash, one with all-weather guidance and the other with larger wings for increased altitude performance.

As the Secretary-of-State for War announced in April last year, the company responsible for the design and development of the new anti-tank missile for the British Army is Fairey Aviation. Owing to its official sponsorship the missile was conspicuous at Farnborough by its absence; but both its unsponsored contemporaries were much in evidence. As we noted, last week, the anti-tank missile picture is rapidly becoming a commercial rat-race, Pye and Vickers both developing their own company-sponsored weapons and the Minister of Supply at the same time buying 150 missiles in the same category from Australia.

Both the Pye and the Vickers weapon have previously been described in our pages. The **Vickers-Armstrongs** Type 891 infantry anti-tank missile—named Vigilant—was displayed in a completely disassembled form. In addition to the body, warhead and two-stage solid-propellant internal motor, the following units could be inspected at close quarters: wing and control surface; longitudinal printed-circuit board; autopilot component assembly; potted autopilot fairing (disposed axially between pairs of wings); telemetry battery; missile battery; skin plug; telemetry deck; E.M.I. telemetry oscillator and modulator; gyro assembly; actuator assembly; and the wire spool.

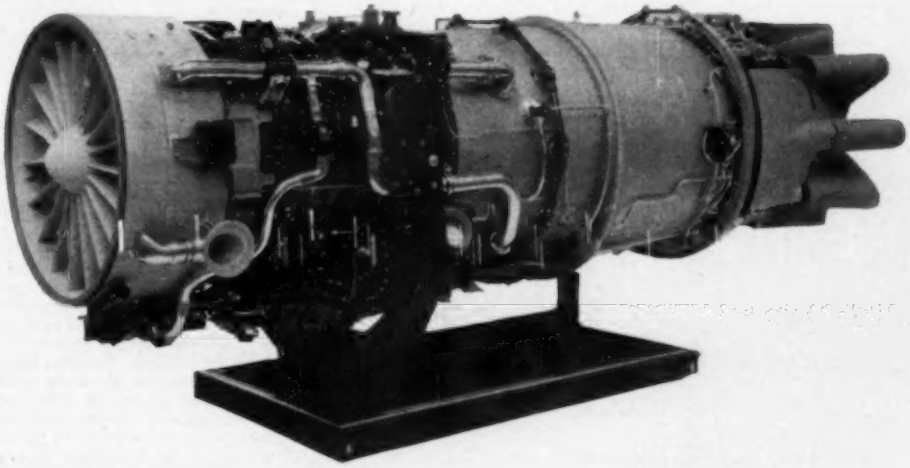
Several complete rounds were also on view, all having the fixed nose probe for fuze actuation which is now standard. A trials missile was painted black and vivid orange, but the production-type weapons were drab khaki. Although the familiar box-type transporter and launcher is by no means being abandoned, Vickers have also developed a lightweight tubular launcher. A round can be carried on this launcher in a small flexible bag. The control unit, cables and optical sighting system were also displayed.

For many months the well-known electronics firm of **Pye, Ltd.**, have been energetically developing equipment for simulating weapon systems and operational situations. The bulk of this work has naturally been of an electronic nature, but, with the recently announced company-sponsored programme for the development of a complete surface-to-surface missile system, Pye are moving into wider fields.

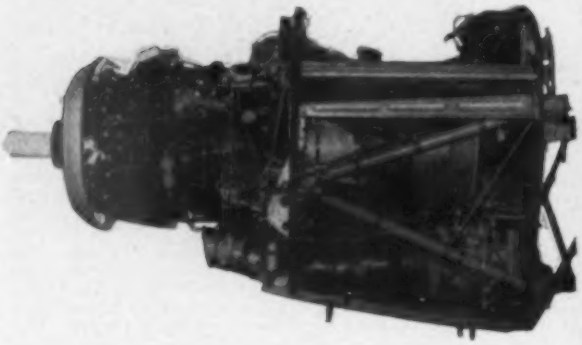
Brief notes on the Pye missile were published in our issue of August 29. Various portions of the weapon could be seen on the company's stand in the static exhibition. The span of the cruciform of wings is 24in and one of the wings is prominently on view (courtesy of T.R.B. Hawxston). The construction is clearly by the wrapped-sheet method, the material being a fairly thin sheet of light alloy formed to a subsonic symmetrical aerofoil section with a commendably smooth external finish. The tandem, solid-propellent internal boost and sustainer motors were manufactured by the Rocket Motors Division of Bristol Aircraft. A complete prototype joy-stick was on view—this having been developed for simulator and control studies—as were a pair of the signal-wire coils, some thousands of feet of thin, greenish wire being tightly wound on cylindrical spools measuring some 10in by 1½in diameter. Yet another portion of the complete weapon system which could be seen was the control box itself. This 20 lb package contains the ground shaping unit, transmitter and power supplies, the ground shaper incorporating a transistorized printed-circuit D.C. amplifier which could be inspected separately.

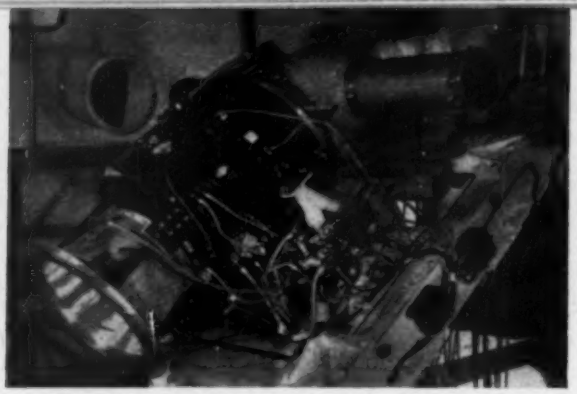
Biggest of our missile programmes is the LRBM, or long-range ballistic missile, in which **de Havilland Propellers** are managing the work of de Havilland Aircraft (airframe), Rolls-Royce (propulsion) and Sperry (guidance). All that could be said, or deduced, about this impressive development was contained in our August 29 issue. The weapon is known as Blue Streak.

Last week an unofficial report claimed that the first Black Knight was scheduled for firing on September 4. Black Knight, designed and developed by **Saunders-Roe**, is the re-entry test vehicle for Blue Streak. As such it may be expected to resemble the Lockheed X-17 in being a lofty multi-stage device, intended to reach a great height and, after reaching the zenith of its trajectory, to be pointed downwards before ignition of the final stage in order to achieve the maximum possible re-entry speed through the atmosphere. Presumably X-17s could have been bought for this purpose and it may therefore be assumed that Black Knight is a more sophisticated vehicle, probably a good deal bigger and capable of carrying a larger payload and a full-scale LRBM nose cone. One newspaper says that it is powered by a Rolls-Royce engine and this suggests that its first stage is driven by the same liquid-propellent motor as that fitted to Blue Streak itself. If this were so it would suggest a launching weight of perhaps 20 tons and a cost which might make parachute recovery of at least the first stage worth while. Another writer says the vehicle is 50ft long and will rise 300 to 400 miles. As we go to press there is no confirmation of a successful first firing, but Black Knight is obviously in a sufficiently advanced stage of development for Saunders-Roe to entertain hopes of being able to reveal



Powerplant of the Boeing 707-420 family is the Rolls-Royce Conway 505. Some notes on its external appearance appear overleaf; internals remain restricted by security. Rating is 16,500 lb; later commercial engines will have guaranteed ratings of 17,500 and 18,500 lb.





Left, above, is the complete Canadair 540 port powerplant, showing the relative dispositions of the Napier Eland turboprop and the Blackburn Palouste A.P.U. Right, above, is the first Armstrong Siddeley P.181 turboshaft engine on test (it first ran last week) and below is the Alvis Leonides 530 long-stroke engine, rated at 600 to 625 h.p.

ON THE GROUND . . .

its appearance. In fact, a big platform jutting out from the missile park at Farnborough (clearly visible in the heading photograph on page 402 of last week's issue) can be explained only by the imminent security down-grading of this impressive vehicle.

The one new weapon which did appear was, of course, the **Avro** stand-off bomb, and this was illustrated and commented upon as fully as security considerations allowed in last week's issue.

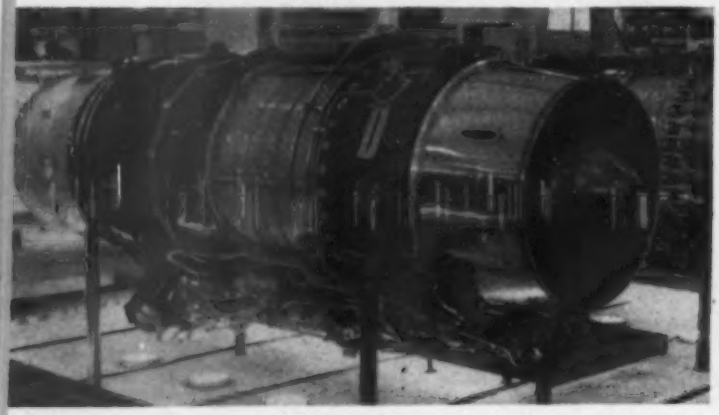
Mention should be made of the **Short/Elliott** G.P.V., the versatile vehicle which has been used for many months for basic research into problems of interception. As we have previously described in *Flight*, the G.P.V. is recoverable by a G.Q. two-stage parachute system and a floatation bag. At the front is the Elliott Brothers (London), Ltd., homing head, radome and the electronic elements of the roll and lateral control systems. The homing head is clearly revealed in a photograph on page 444. The latest pattern of head comprises a conically scanned microwave aerial and a conventional receiver which, after demodulation and smoothing stages, provides outputs which precess a free gyro in the direction in which the line of sight to the target is moving. A follow-up hydraulic servo responds to gyro pick-off signals to keep the aerial pointing towards the target.

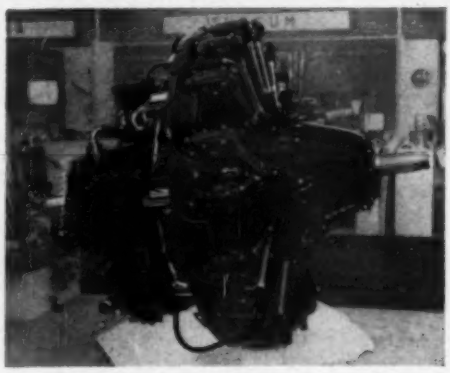
Various types of guns and associated equipment—in particular the 30 mm Aden and the Hispano 825 (British M.A.R.C.) of the same calibre—could be found at Farnborough, and spin-stabilized rockets were more in evidence than ever before. Possibly the most important new rocket package is that developed by **Microcell** for the English Electric Lightning. As noted in our description of this aircraft on August 29, it carries two such packages, each housing twenty-four 2in tubes and retracting flush with the aircraft fuselage. The launcher, which embodies advanced principles of construction, is pictured on page 444. The dark-coloured rectangle projecting from its inner side houses the electronic launching-sequence rippling unit and fuzing circuits.

Engines and fuel systems

THIS year every engine manufacturer had something quite new to exhibit: Alvis had the long-stroke Leonides 530, Blackburn the 840 s.h.p. A.129 turboshaft engine, Bristol-Siddeley the 24,000 lb-thrust reheat Olympus (Bristol) and the P.181 and 182 thousand-horsepower turbines and PR.23 rocket (Armstrong Siddeley), de Havilland the DGJ.10 uprated Gyron Junior, G.E.-built Gnome

It is not normally possible to relate particular marks of engine to operational British aircraft, but this de Havilland Gyron Junior DGJ.1 (7,000 lb thrust) was exhibited with an NA.39 intake and the high-capacity bleed manifold for full supercirculation blowing.



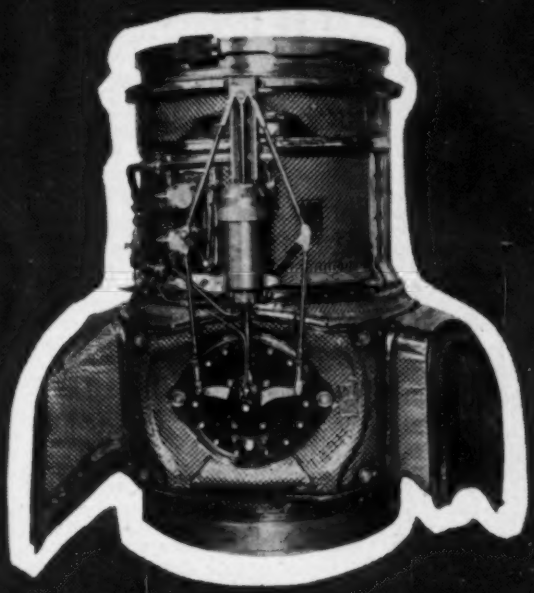


and new Spectre rockets, Napier the Triple Scorpion and Rolls-Royce the RB.145 turbojet. This is a healthier crop of new engines than has been seen at an S.B.A.C. show for some years, and there are many other designs under development—such as the engines which are competing for the propulsion of the R.A.F.'s future strike aeroplane, the RB.141 low-consumption airline powerplant and the big Rolls-Royce liquid rocket motor for the British LRBM. Virtually all that can be said of these new engines was contained in our last two special issues. Curiously absent is any suggestion of a diminutive shaft-turbine comparable to the Allison 250, or anything connected with nuclear propulsion, high-energy fuel or dual-cycle engines (such as a turbo-ramjet).

Now highly developed, but not previously exhibited, the **Rolls-Royce** Conway 505 was displayed as a complete package for a Boeing 707-420 nacelle. The airframe company took pains to ensure that no airframe accessories were installed, and that the nacelle structure was also absent. Nevertheless it was possible to inspect the Greatrex-type nozzle (picture last week) and the thrust-reverser, which in principle is similar to that of the Comet. Low on the port side of the compressor could be seen a large-diameter bleed pipe, which supplied hot air for de-icing the intake and guide vanes and a second branch leading to a fuel-heater. On the starboard side could be seen the oil cooler for the Sundstrand drive, fed with air from about the second l-p. stage, separated from the compressor case by the fuel-cooled main oil cooler. The latter will presumably permit deletion of the small intake at the front of the pylon strut which admits oil-cooling air in present Boeings.

Although it is as yet in an early stage of development, the Rolls-Royce RB.141 can be assessed in general terms. As the powerplant of the Airco D.H.121 it has been specially designed for minimum fuel consumption, weight and noise level, and maximum life. The by-pass ratio is appreciably greater than that of even the latest Conways, and certainly the intake hub/tip ratio is very low. An unusual feature is the employment of intake struts which are not truly radial but almost tangential to the hub fairing. This is presumably done in order to accommodate thermal expansion and is also a feature of the intake struts of early Avons. The latter engine, however, had but six struts, whereas the 141 has nineteen, each looking like a guide vane or stator blade.

The 141 seems to be commendably short, and it may be that, whereas the hot, central core has very high compression (and may perhaps use Tyne parts), the low-pressure compressor may have only about four stages. External features include a bleed-air pipe for intake heating, an accessory package on the lower port side driven by a shaft projecting through the intermediate casing, and duplex fuel galleries feeding more than the ten burners used in the Conway (there appear to be twelve). There seem to be bleed-duct attachment faces beneath the combustion chamber, and cer-



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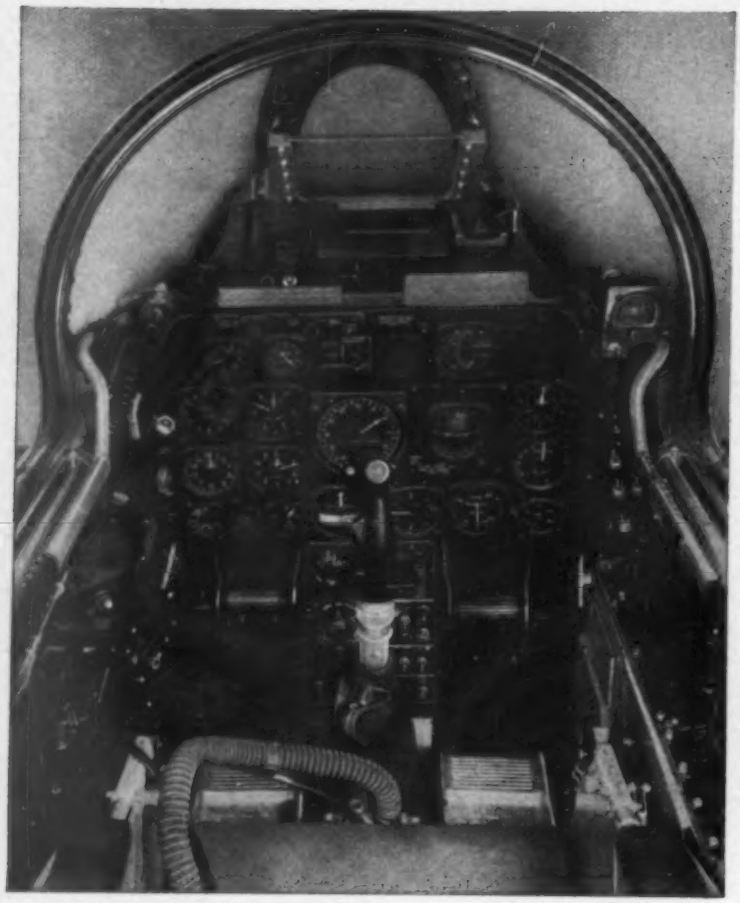

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ON THE GROUND . . .

tainly the engine will be designed for supplying large quantities of air. Rated thrust will initially be about 12,000 lb.

A photograph illustrates the finalized powerplant for the Canadair 540 (CL-66). The Napier Eland, of 3,500 e.h.p.—recently awarded an unrestricted C.A.A./A.R.B. Type Certificate—has a Rotax low-pressure pneumatic starter fed with air from the Blackburn Palouste 502 auxiliary gas turbine mounted in the port nacelle. As the picture shows, the Palouste package takes up little room, and also provides drive pads for shaft accessories. Ground-air conditioning could also be effected by this system. Notes on the reheat systems employed in the Armstrong Siddeley Sapphire 7R and Bristol Olympus 201 were published last week.

Among a wide range of controllers and valves for various fluids, **Gloster Technical Developments** manufacture a true mass flowmeter and a high pressure flowmeter. The former, TDD 160/1, measures mass flow directly, without the need for a separate device to calculate separately variations in specific gravity. This is performed by adding to the fluid angular momentum proportional to the mass rate of flow and removing it again by extracting a torque proportional to the mass flow. Angular momentum is imparted by a motor-driven impeller driven at constant speed by an internal motor, which thus imparts a constant velocity to the fluid at right angles to the flow. Immediately downstream is a turbine, which removes this velocity by deflecting against the restraining torque of a spring. This deflection, which is proportional to the rate of mass flow, is measured and presented as a meter indication.

In the high-pressure flowmeter a tapered plug is displaced as a function of the flow, and by suitably combining initial spring load, spring rate and plug taper a linear movement is achieved. This is transmitted to an indicator by means of a potentiometer. This flowmeter, which does not carry specific gravity correction, is in general better suited to fluids other than aircraft fuels.

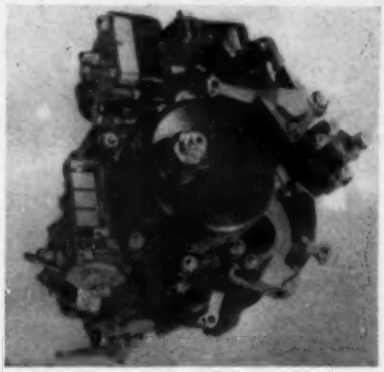
H. M. Hobson were showing on their stand the Microjet pressure ratio controller that is being built under Solar Aircraft licence. It computes the ratio between any two pressures with a minimum delay and may be used either as a ratio meter or a pressure ratio senser irrespective of the absolute value of the pressure. It clearly has applications outside the aircraft industry and Hobson say that they are developing a simplified and less expensive unit for industrial use. A new unit designed by the firm is a fuel-flow proportioner, clearly for a large engine. Metering is performed by cycloidal rotors powered by a speed-governed gear type air motor; this could maintain the fuel supply in a failure condition. Pressure regulating valves control the fuel pressures into each of five cells (in this unit, the actual number is arbitrary) and since these are set to the value of the outlet pressure, fuel slip is negligible and close running components are not required.

This ability to operate on fuel that does not have to be microscopically filtered is in evidence on the stands of several manufacturers. It has come about as the result of a need to call a halt to closer and closer filtration rather, perhaps, than a deliberate attempt to reverse the process, but the trend now is clearly in the right direction. These principles are among those adopted by **Dowty**, who were showing examples of their well-known spill burner systems for gas turbines, both sub- and supersonic, and **Lucas (G.T.E.)**, who had on display a comprehensive array of fuel system components. These are in service on many British engines.

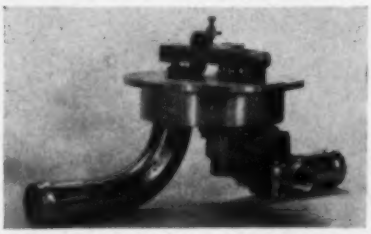
Flight Refuelling had on display some of their very comprehensive range of ground and in-flight refuelling valves; a public reminder of this company's work was the refuelling probe now to be seen on the Handley Page Victor. A new valve, the Mk 39 refuelling/defuelling unit, has been produced which embodies an electrically selected refuelling and defuelling feature; the basic design, however, follows established F.R. practice. Another component on show was an equal-flow valve, lighter than existing transfer valves, and designed to permit equal emptying of wing or drop tanks. It can be recalibrated for asymmetric systems. On this stand also was an intriguing model of a Wessex helicopter being refuelled from a frigate. The refuelling line was simply "dunked" into the ship's fuel tank.

The Lucas GDS fuel pump, used on the Rolls-Royce Avon RA.29, has a rated output flow of 1,300 gal/hr.

H. M. Hobson's fuel-flow proportioner uses cycloidal rotors with relatively wide running clearances, driven by a governed air motor.



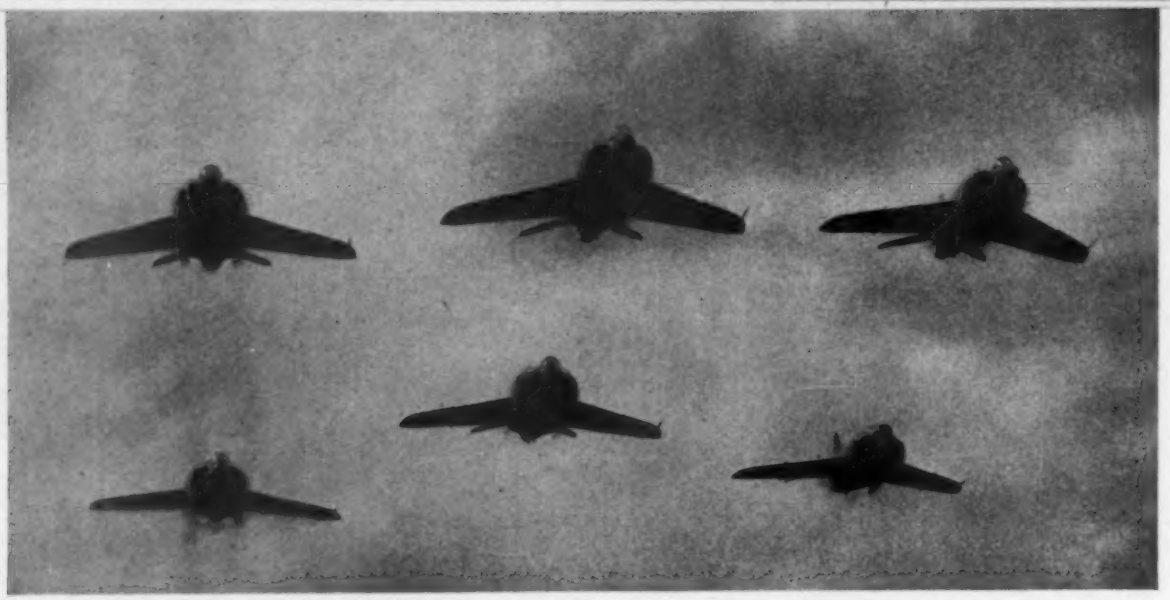
The Lucas simple flow-control unit now in production for the Rolls-Royce Tyne.



This equal-flow valve manufactured by Flight Refuelling permits equal emptying of wing or drop tanks into a central fuselage tank.

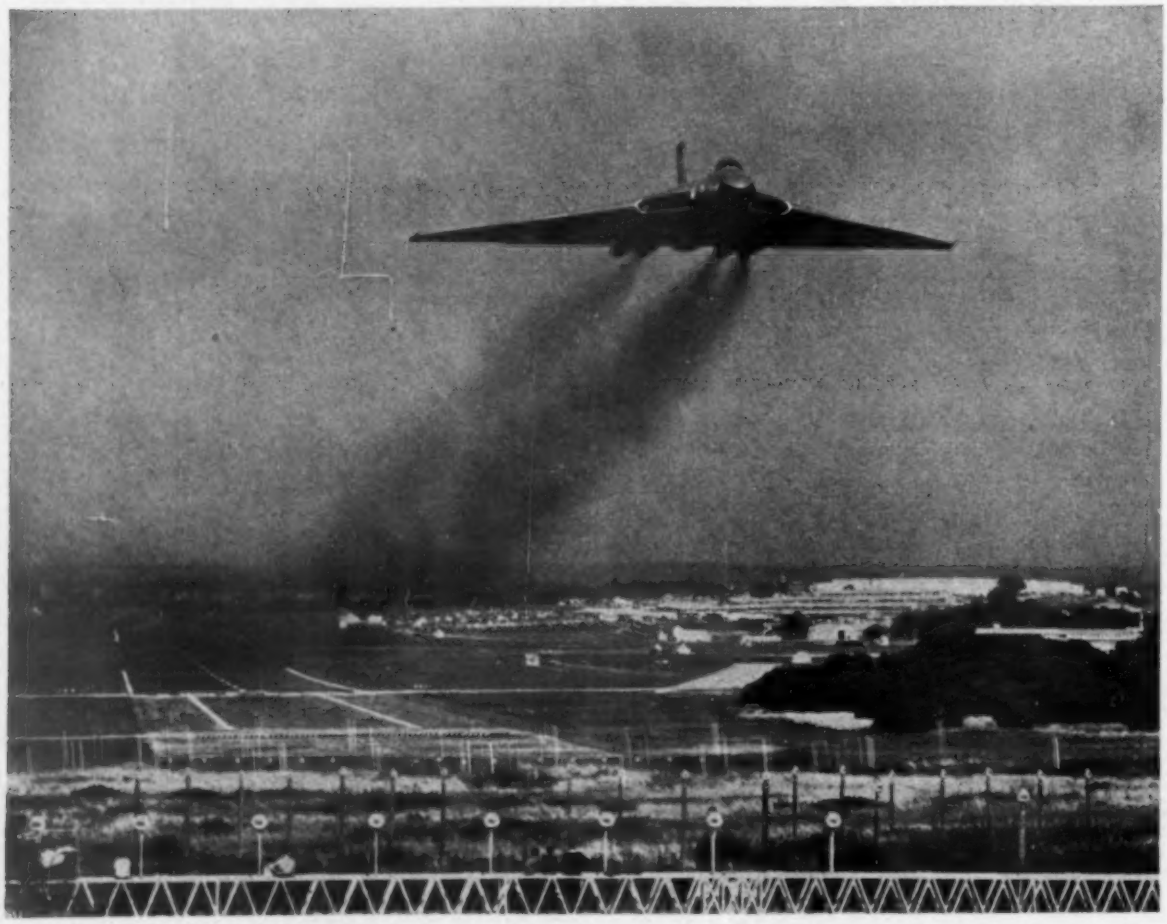
Refuelling equipment is also the special concern of **Avery-Hardoll**, who manufacture replenishment equipment for ground installations and work in association with Gloster Technical Developments on airborne equipment. Typical units in the latter category are refuelling couplings in a range of sizes, and an overwing refuelling filter cap for an integral tank. This provides a leak proof seal irrespective of aircraft attitude and the sealing increases as internal pressure rises.

Few major changes are taking place in the aircraft part of the fuel system although some new equipment has appeared during the year. **Plessey** are offering a plug-in fuel booster pump built under licence from Pesco. This is a self priming pump with a lift of 6 to 15in depending upon altitude. A developed contents gauge is among **Simmonds Aerocessories'** contributions to the show. This is Pacitran, a transistorized version of the Pacitor gauge which is suitable for both fuel and liquid oxygen. Compensation for density is provided.



Farnborough Sound and Spectacle

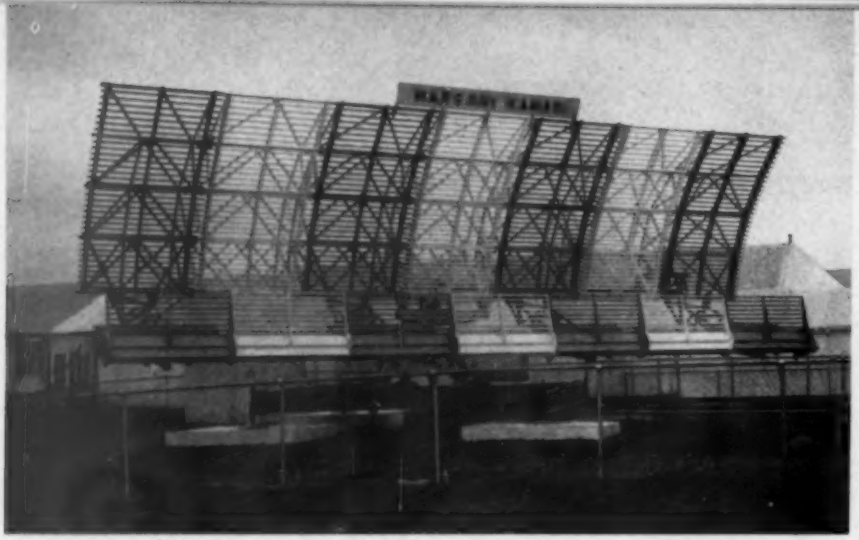
Nudging Mach 1, the six Vickers-Supermarine Scimitar F.1s of No. 803 Naval Air Squadron flash low above the runway. Below, in an out-of-the-ordinary study, departure of the LABS-bombing Vulcan B.1.



Entering the second of their two introductory loops are the twenty-two fabulous Hunters of No. 111 Squadron, R.A.F. Their evolutions set a new standard of aerobatic technique.

In the Hunter routine put on by Hawker test pilots the T.7 with two 100-gal auxiliary fuel-tanks and two 1,000 lb bombs was third and last away. Its mode of departure is depicted on the right.

The Westminster, Wessex and Whirlwind helicopters pay their respects before the president's enclosure, after an integrated performance of quite exceptional merit and technical interest.



A highlight of the static exhibits —"static" in this case being something of a misnomer—was Marconi's vast S.264 50 cm surveillance aerial.

ON THE GROUND...

Cossor's new CR.787 airfield radar is a successor to the same company's CR.21. Comments on the new equipment appear in the text on the right.

Radio and radar

THE United Kingdom was perhaps the first country to put ground scanning radar seriously to work in the service of air-traffic control; it did so with the commissioning of the original microwave early warning station at London Airport. This happened a good many years ago, and since that time radar has gone on expanding to the point where it is no longer an adjunct to A.T.C.—it is an essential part of it. Complicated as A.T.C. is even now, the coming of jet movement on a large scale and the mixing of this traffic with conventional kinds will still further complicate a situation which internationally is giving rise to a great deal of hard thinking.

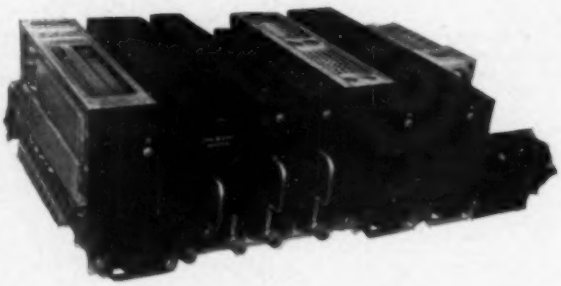
The announcement by the M.T.C.A. of plans for large-scale expansion of the ground radar facilities in the technical support services of the U.K. airways system came as a recognition of the seriousness of the problem which confronts the civil air transport business. It is a step fully justified by the intrinsic worth of radar as the "eyes" of the controller; and it is emphasized, if emphasis be needed, by the present unsatisfactory state, internationally speaking, of the short-range navaids position.

So for the civil aviation visitor the first notable thing about the radio side of the S.B.A.C. Show this year was the industry's concentration on radar in air-traffic control. The second obvious highlight was the spectacular advances which have been made in reducing the size and weight of airborne equipments, by the use of new techniques and the simultaneous promotion of greater reliability.

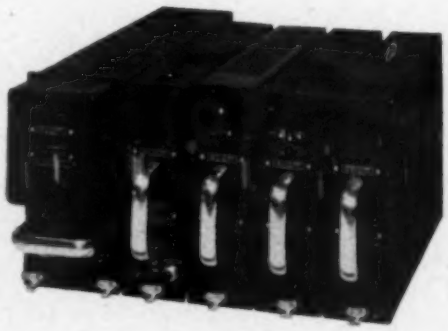
One of the most impressive things on show to the aviation public for the first time this year was the **Cossor** secondary radar system. Cossor have been working steadily on this and are largely responsible for the design features of a system which is going to be of first importance in the years ahead. In the closest association with an American firm, the company has carried this piece of systems-development along in a way which has enabled it to achieve a high degree of international agreement without any clashes of the kind which have bedevilled so many other questions of facilities standardization in the international arena. As a result there is substantial agreement on both sides of the Atlantic about what a secondary radar system should look like and about the details of the airborne component. Most of the new Boeing 707s and DC-8s now coming along make provision for the transponder, and the next generation of British aeroplanes will do the same.

The secondary radar antenna was shown mounted on the antenna of the CR.787, a new radar which Cossor have developed from the CR.21 for application where greater coverage is needed. The CR.787 is an S-band-cancelled radar, has a quarter-wave plate to deal with rain-clutter, and has been designed as a general-purpose radar for use in a wide range of A.T.C. applications. A new display unit, the type CRD.23 was demonstrated in association with the CR.787. This display unit, in the modern trend, shows how associated equipment can be progressively built up to suit particular requirements for facilities such as video mapping, display of C.R.D.F. identification, superposition of various markers for tracking and transfer purposes by interscan techniques and, of course, for display of returns from the transponders of the secondary radar system.

Always in the forefront with the application to their airborne radio sets of new circuit techniques and devices, **Standard Telephones and Cables** exhibited some beautiful examples of the



Both Standard Telephones and Cables and Elliott are showing packaged V.H.F., V.O.R. and I.L.S. equipment. Standard's is above, Elliott's below.



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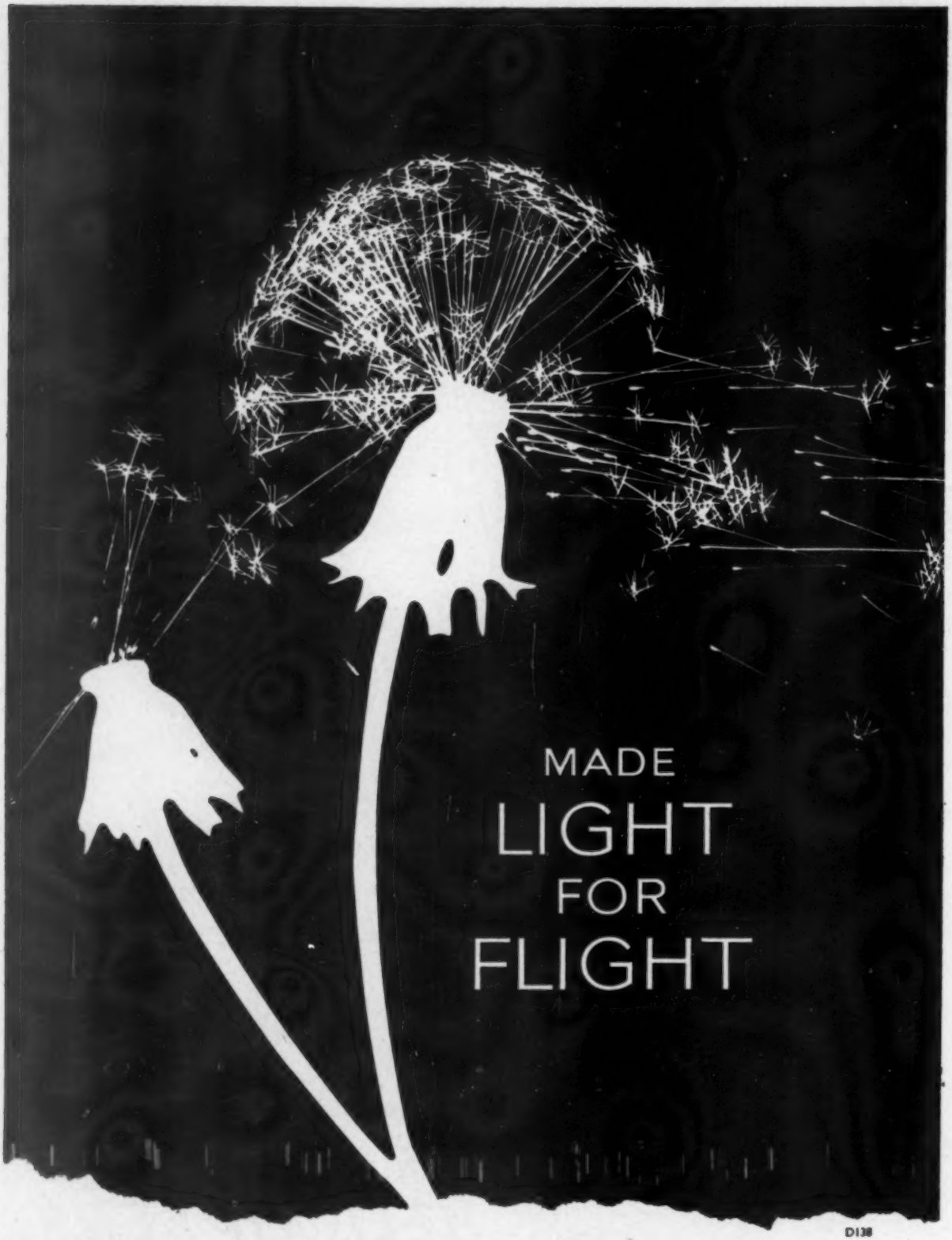
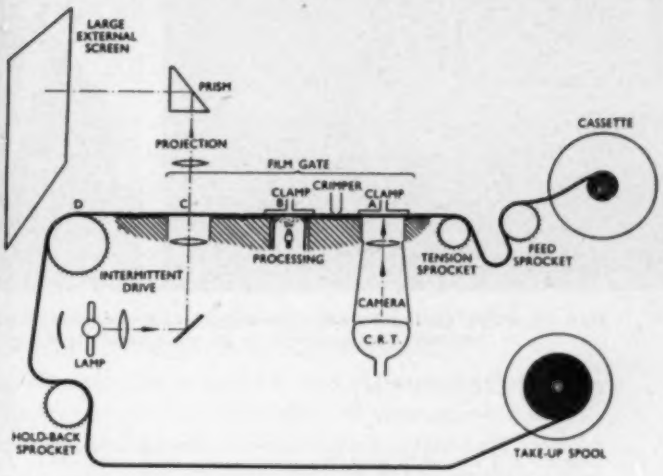


DAGENITE AIRCRAFT BATTERIES

PETO AND RADFORD, 137 VICTORIA STREET, LONDON, S.W.1.



A spectacular exhibit, on public show for the first time, was Kelvin Hughes' rapid-processing photographic projector. On the left is the Marconi radar console from which airways information is obtained and the actual projector, in which is a repeater C.R.T. The basic principles of the system are shown on the right.

ON THE GROUND...

engineering of equipments using transistors and printed connections. Chief of the four equipments incorporating these design features is the STR.23/34/35/36, which is a combination of transmitter, receiver and power supply for the complete V.H.F. services of communications, V.O.R. and I.L.S. Its specification conforms to the most up-to-date requirements for the international radio services in these V.H.F. bands. The S.A.10—also on show—is the S.T. and C. airborne intercommunication and audio-control equipment, in which the same design techniques are evident. This equipment provides the customary facilities for service selection of radio facilities by crew members and intercommunication between them. Both this and the V.H.F. communication and navigation equipment have been specified by B.E.A. for their Vanguard and Comet aircraft.

The two other examples in the transistorized range system shown by S.T. and C. were their high-precision radio altimeter derived from their already well-known STR.30B, and the low-frequency special purpose receiver which will be used for the automatic reception of meteorological teleprinter broadcasts covering the North Atlantic routes. This new system of flight communications, primarily aimed at reducing the flight-deck communications burden, for essential weather, has been under systematic development with the U.K. and Canadian Governments for some time now. The S.T. and C. receiver was shown with the Creed teleprinter with which it will be used, the two together having now been reduced in weight to 45 lb.

The four equipments break entirely new ground in the aircraft radio engineering business. Reductions in size and weight of the equipment are the visually obvious first advantages, but the expected high reliability, reduced power demand and consequently reduced waste heat will all contribute to cutting down an airline's radio engineering costs and simplifying the installation problem.

One of the vital but "behind-the-scenes" services on which an airline leans very heavily is its point-to-point communications system. Traffic volumes have grown enormously over the last few years and will continue to do so as the business of competitive selling of space intensifies and as the needs of a very fast aeroplane anywhere on the route pattern grow more clamant. Of special interest therefore is the Standard Telephones exhibit showing some of the electronic pieces which are brought together to customer's demand to build STRAD, the company's name for its transistorized automatic or semi-automatic message storage, relay and transmission system for employment in point-to-point telegraph centres—or for that matter, in computer and data-processing installations. Magnetic drum and ferrite matrix storage devices were among the elements shown.

Knit together by the A.T.C. theme, **Marconi** had a comprehensive display of their scanning radars and of devices making use of, and supplementing, radar-derived information. The company adheres to 50 cm as the main stream of its radar development and showed special-purpose derivatives of its original highly successful long-range radar, Type S.232.

The two new radars are the S.264 and S.264A; the prime purpose of the first is for coverage, in excess of 100 miles, in the large terminal area; the second, of ten times the peak power, is for extended coverage over the airways system. Both radars have the very effective M.T.I. cancellation, excellent cover down to very short ranges and the highly stable presentation notable in the earlier radar. Fixed-coil displays, now usual in the civil family, confer great versatility. A new high-gain antenna system greatly improves the resolution of the S.264 radar types.

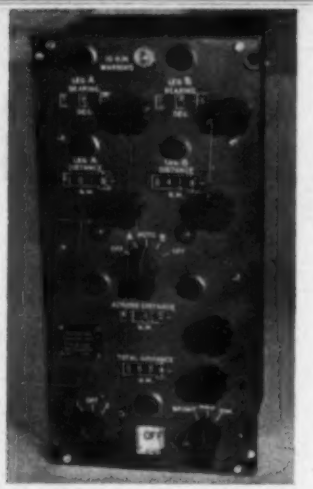
Judged against the back-drop of announced U.K. policy, perhaps the most important part of the Marconi display was an operations room in which had been brought together a large number of the special devices that are now becoming important adjuncts in the art of radar controlling. Under the generic name of civil aviation data handling, various means were shown for extracting selected data from the mass of information on a raw radar and using it in a synthetic, much-brightened display for use at an airways control position in association with a flight progress board. One of the obvious virtues of this arrangement is that the whole control position can be normally lighted.

Also shown were video mapping techniques for grafting on to radar displays, for giving environmental information about airway boundaries, for reporting fixes and holding areas, and as a means of transferring data from one radar controller to another, e.g., from an airways to an approach controller, by electronic methods. "Track-while-scan" and "rate-aiding" and an electronic method of predicting time of arrival of an aircraft over a given point, e.g., its next reporting point, gave homogenity to the whole display, which altogether presented a very comprehensive demonstration of the methods and techniques available to the radar controller.

There was the usual full range of Marconi airborne radar equipment, much of it well-known by now and rapidly building up operational flight time in airline service and very soon to go into operation with B.O.A.C.'s Comet 4s. The company's new A.D.F., the Type 712, first shown in 1956 and now in service, has received the warmest possible welcome from the pilots who have used it. It is the only instrument of its kind in airline service, is a radical advance over all previous A.D.F. sets, and is unique in the simplicity and positiveness of its crystal-locked auto-tune mechanism.

The principal new airborne equipment to attract attention was the Marconi AD.2300 Doppler navigation radar. The first Doppler to be designed specifically for civil airliners, the design uses the C.W. transmission mode and frequency-modulation techniques to separate the transmit and receive paths. The AD.2300 has already undergone stringent flight-proving, especially in the high-altitude regime, and appeared at Farnborough fresh from its own recent grand tour of Europe. It is understood that the AD.2300 is about to go into a B.O.A.C. Britannia for an intensive series of evaluation trials and information-gathering over as representative a set of terrain conditions as can be sampled. A navigation computer, the Type 4381, was also on view in association with the AD.2300 to show some of the things that can be done with the basic information, ground-speed and drift-angle which the radar yields.

Marconi's Commonwealth association with Canadian Marconi and A.W.A., Ltd., of Australia was, as in past shows, in strong



From left to right are shown the Marconi airways control console with fixed coil display unit, synthetic P.P.I. picture and flight progress board, automatic fixer equipment by the same manufacturer, and the Marconi AD.2300 Doppler navigator controller.

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evidence. The Canadian company exhibited their own airborne Doppler and also an F.M./C.W. system now being trial-flown by T.C.A.; the Australian organization displayed one of its contributions to the range of Marconi airborne equipments, the AD.704/706/708 for V.H.F. communications, V.O.R. and I.L.S. reception. This latter equipment is on B.O.A.C. Comet 4.

Operating in conjunction with Marconi's S.264 radar was **Kelvin Hughes'** rapid-processing projector, screening the current radar display in a special site in the outdoor exhibition. Already in civil and military use in the United States, and under consideration for use in this country, this British equipment was having its first public showing at Farnborough.

Decca exhibited the Mk 10 and Dectra receivers and the integrated air navigation system (D.I.A.N.) which combines Doppler, Decca and Dectra and displays all on the Flight Log.

The Mk 10 receiver is the latest development of the basic Decca System and has new features which effectively remove the main criticism of Decca as an air aid. Lane identification is completely automatic in that the appropriate Decometer readings are automatically correcting, i.e., no cross-referencing to a fourth meter is now required. Zone identification is incorporated and the system is therefore for all practical purposes "one shot"; it is unambiguous and very much simpler to set up—this last a most important point when considered in terms of flight-deck workload. If an outage occurs for any reason the equipment re-sets itself without intervention by the pilot. B.E.A.'s evaluation of the Mk 10 is understood to have been highly satisfactory.

Dectra is the company's long-range system. The present North Atlantic system uses two stations in Canada to generate the tracking pattern over the route, while one of this pair plus a third station in Scotland gives the ranging pattern. The Flight Log displays positional information.

The system has been under intensive evaluation for some eighteen months, firstly by a Valiant of A. and A.E.E. Boscombe Down, who reported that the system accuracy and reliability were of the expected high order. Airline trials by B.O.A.C. and P.A.A. started soon afterwards. P.A.A.'s evaluation, carried out in twenty-seven round trips, confirmed these findings and additionally showed that on a number of occasions of high-precipitation static—at times putting all other flight radio aids out of business—Dectra continued to function. All in all a most impressive performance, of major importance for North Atlantic traffic control of the future. Other carriers—T.C.A., S.A.S. and Swissair—are now trying the system for themselves.

To round out the qualities of Decca/Dectra and the Flight Log, the marriage of information derived from the Decca Company's Doppler airborne radar is a logical next development. The economics of the business will prevent a majority of the world's air routes from having ground-based long range navigation cover and the need for airborne Doppler radar is plain. Most of the new generation of aircraft are being prepared for its carriage. Clearly there is a good deal of merit in the D.I.A.N. combination; it permits a common display and can reduce the weight and complexity of the computer with which Doppler radars are associated, because much of the combination is done in the Flight Log charting itself, e.g., the chart can do the "distance to go" or "distance gone" or "present position" sum by direct display. The D.I.A.N.-equipped aeroplane could thus operate into and out of the highly accurate coverage of Decca in the airway and terminal areas, use Dectra in the long-distance cruise where the ground stations exist and Doppler radar where they do not.

These Decca developments are doubly important in the light of the I.C.A.O. discussions to take place in early 1959 on radio-aids standardization. The central issue at this meeting will be much the same as it was in the 1946 attempt: to reach international agreement on radio facilities. Once again it will be the U.K. concept of an area-coverage system of high accuracy versus the U.S. insistence on a single-source aid. However, in the twelve years that have gone by since the U.K. paddled its lonely canoe, there has been a profound swing of opinion among a rising number of influential states in the international policy-making circle. The swing is due not only to economic considerations of the high cost of providing radio facilities in high-traffic regions; it is also due to the realization that no known point-source aid is capable of giving the necessary definition to flight in airways congestion descent into and climb out of airports; holding areas which must be economic both of airspace and turbine fuel conspire to create an extremely complex environment.

The U.S. solution to the problem seems to be VORTAC—the joining of the distance element of TACAN to the conventional VOR. The issue at the 1959 I.C.A.O. conference will not be clearly resolved, but one thing is clear—there is no longer any real room for compromise; in hard, practical aviation terms, compromise implies still more electronic boxes in the air to deal with different ground systems, and multiplication of the flight techniques which pilots must master in order to deal successfully with highly congested traffic environments. Both of these things have profound and direct influence on airline economics.

The latest product from the ground radar side of Decca is the Type D.A.S.R.3 long-range surveillance radar for civil air-traffic control purposes primarily in the terminal area. A major feature of this design is the use of two separately fed back-to-back antennæ to obtain the solid cover needed for the terminal zone job. All targets, from those close in and at the highest altitudes to those far out at the radar horizon, are within the vertical patterns of the combination of antennæ. The radar, which operates on 10 cm, has a high scan-rate, uses variable polarization to deal with precipitation clutter, and utilizes the company's "air target indication" techniques to give suppression of the permanent echo pattern.

The Decca Radar Company's display showed that they, too, have been devoting a great deal of development work to the operational side of radar utilization in traffic control. To reduce to manageable proportions by controllers the vast amount of information supplied by a number of radars, each with its special function, the company were showing typical operations-room arrangements designed to facilitate extraction of essential radar data, to correlate it with other data about the traffic area (such as runway positions, fixed reporting points and the like) and to give positive means for transfer of responsibility from one radar to another.

The widely used Decca Type 41 storm-warning radar was on view again, but with new features shown by operational service to be of value in exploring storm centres. The upward-looking capabilities have been increased very markedly to permit exploration of cumulo-nimbus clouds at very high vertical developments, and incorporation of iso-echo contouring facilities, familiar to the pilots who use airborne storm radars, permits comparative estimation of the rate of rainfall actually taking place from the cloud. It will be recalled that the Type 41 has a maximum range of 250 miles and has been expressly designed for continuity of service in areas where high level maintenance effort is not available.

A recent addition to the variety of V.H.F. direction-finders used in aviation was the **E. K. Cole** Type CE.178. This was the first Farnborough for this low-cost equipment of simple and robust design. It uses an elevated spinning Adcock antenna mounted at the top of a 28ft-high mast. Bearing indication is on a cathode-ray tube display unit and is free from sense ambiguity. If necessary, for reasons of siting or association with some other equipment, e.g., a radar, the antenna installation and the display equipment can be separated by up to two miles.

The latest variant of the now well-known Ekco cloud-warning

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radar, the Type E.160, was shown to demonstrate new operational features. Basically similar to the original E.120, which has now accumulated thousands of hours in B.O.A.C.'s Britannias, the E.160 has alternative switching of beam shape for cloud-warning and terrain mapping. The E.160 is destined for the Comet 4, Boeing 707 and Vanguard. A separate adjunct giving drift in a very simple way is available if required.

The nose radars which E. K. Cole have produced up till now have all operated in X-band. The company was this year showing their parallel development of airborne radar in C-band for those airlines who prefer the longer waveband operation.

First interest on the **Murphy** stand went to their showing of a new passenger-announcement equipment for aircraft use. It is a completely transistorized amplifier, the first British unit of its kind, and gives an output for the cabin of 40 Watts for the remarkably low weight of 8 lb, and in a very small volume it contains the provisions for captain's and steward's microphones and for a music input. This equipment, called the Type MR.310T, was shown with a provisional design of an airborne tape-reproducer to be used for music over the aircraft's passenger-address system. It is designed for D.C. operation and uses a double-track tape giving two hours' playing time, but the built-in automatic switching allows the tape to play continuously on that two-hour cycle if required.

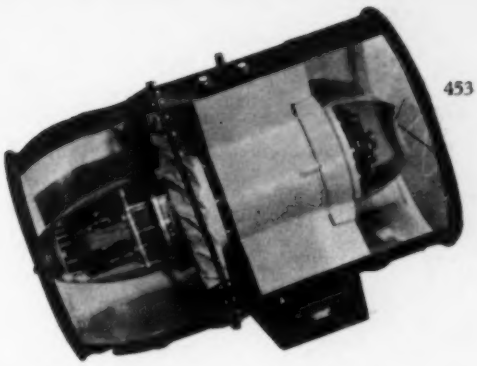
Generators and drives

THE problem of brush-wear has been acute ever since the Battle of Britain, and now that commercial airliners are flying at up to 40,000ft several manufacturers have produced brushless alternators which remove the problem entirely. Two such patterns were on view this year and both derived their D.C. fields from an A.C. exciter by way of silicon-diode rectifiers mounted on the rotor shaft. Thus the rectifiers revolve with the rotor assembly, dispensing with an extra commutator and brushes.

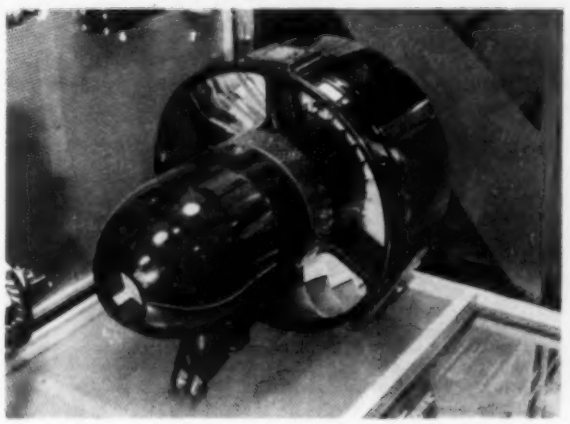
Although the constant-frequency, fully paralleled A.C. system is the subject of a certain amount of controversy, its onward march in the aircraft field continues unabated. The increasing adoption of such systems has necessitated provision of special emergency power supplies, particularly where electric/hydraulic powered flying controls are used. One of the most favoured arrangements is to employ a ram-air turbine, and such devices have been under development by several British companies for a number of years. Two major ram-air turbine units were on view this year and in both cases the manufacturer stated that the drive could be applied to any of a variety of accessories.

It is still too early to state categorically that future aircraft systems will necessarily involve constant-frequency A.C., since each installation is considered on its merits. The impressive array of new D.C. generators on show at Farnborough emphasizes that there are many applications where D.C. systems are preferable; conversely, one could draw the opposite conclusion from the increasing evidence of work on constant-speed drives.

An interesting and undeniably important development is the constant-speed drive by **H. M. Hobson**—quite different from the unit seen last year. During recent months this has been under a continuous process of improvement and is now emerging as a formidable contender for the wide market for which such drives are suitable. Basically rated at 53 h.p., the drive weighs 57 lb; it is designed for use with an 8-pole 6,000 r.p.m. alternator, and can control the latter within ±2 per cent under steady-state conditions. The drive is designed for an input speed range of 2.5 : 1 and to withstand a transient overload of 100 per cent for 5 sec. Basically the Hobson unit is a hydro-mechanical device using a differential geared drive, the latter substantially relieving the load on the hydraulic portion of the system. Hobson have produced two versions of the drive, one being associated with a 30kVA alternator (and obviously designed with an eye to the Airco D.H.121) and the other with a 40kVA machine (and therefore of a size suitable for the VC.10). Hobson expect that, with further development, the 40kVA version could be made suitable for alternators of up to 60kVA output.



Emergency ram-air turbo-alternators are discussed on this page and page 454; above is the Rotax 15kVA machine and below is the similarly rated Plessey drop-out unit which provides emergency 400 c/s supplies for the Vulcan.



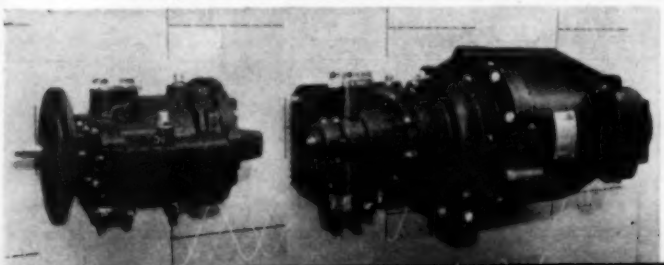
A revelation during Farnborough week was the announcement by **Rotol** of their licence to manufacture—and develop, if necessary—the well-proven constant-speed drives by American G.E. These neat units incorporate a hydraulic pump and motor with balls instead of plungers; the three present ratings are 9, 20 and 40kVA, the corresponding weights being 35, 39 and 65 lb. Under steady-state conditions speed can be held within ± 1 per cent; all three units can feed parallel A.C. to a common busbar and can be disconnected in the event of failure.

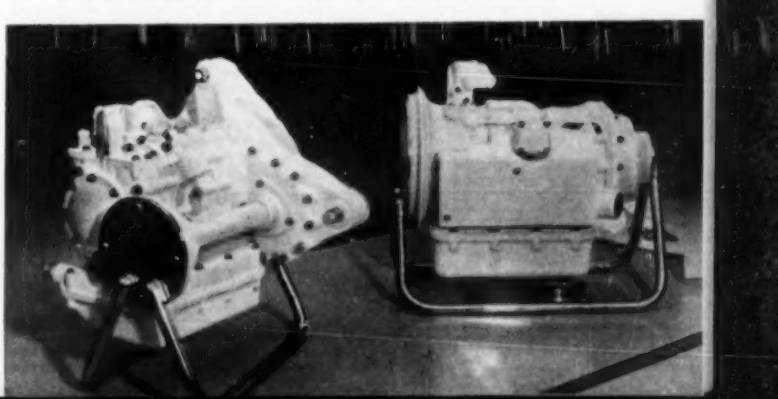
Another important hydro-mechanical drive is the Type 8005 by **English Electric**. This is a direct replacement for the unit at present used on the Boeing 707, but on the English Electric stand the drive was shown coupled to the British company's own 40kVA brushless alternator Type 2040. The drive weighs 80 lb and is suitable for an input speed variation of 2.7 : 1, the output being held at 6,000 r.p.m. ±2 per cent. A free-wheel device is included; this was originally introduced on the American Sundstrand to overcome the effects of backfiring in piston engines, but it has been found to be eminently suitable in parallel A.C. systems for counteracting "load swinging" between alternators. Governor control of the constant speed is effected by means of an electrical signal derived from the paralleling network; two versions are available, one having a two-phase motor operating a cam in such a manner as to bias the control springs, and the other—favoured for civil aircraft—consisting of a solenoid operating on the magnetic flyweights directly.

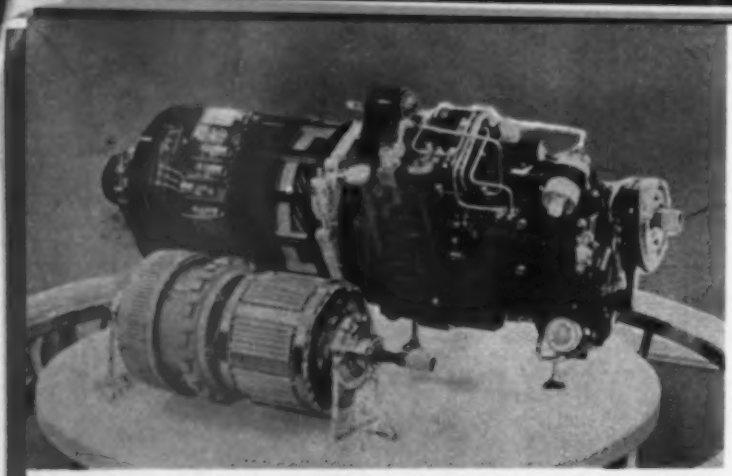
Frequency and voltage control units are also major products from Bradford. A typical frequency controller is the Type 7507. This utilizes a double resonant circuit as its frequency reference

Right, the Hobson constant-speed drives. These important units—differing from the 1957 model—were rated at 40kVA (left) and 30kVA.

Below, principal units in the Rotax constant-frequency A.C. system: on the left is the Lucas variable-speed hydraulic pump and motor and on the right is the 40kVA brushless alternator (see text, page 454).

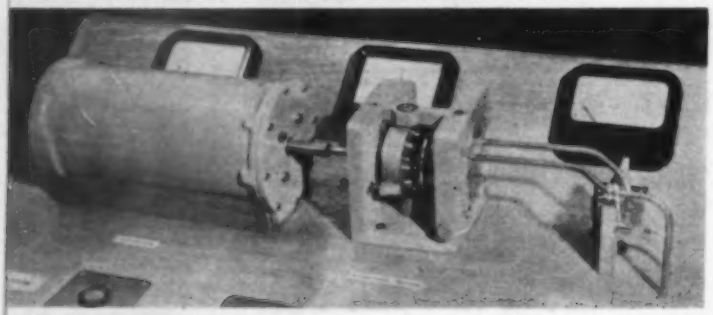


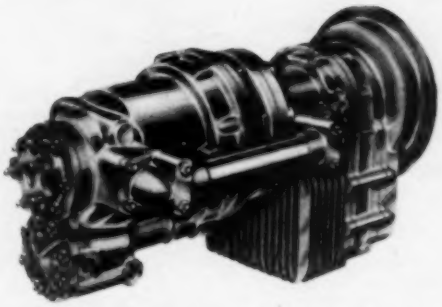




One of the most highly developed constant-speed drives is the Sundstrand, the British licence for which is held by English Electric. This is the Bradford-built 40kVA package, which is now in production.

Below, the Rotol hydraulic constant-speed drive, showing the alternator, motor and Lavs relay and throttle.





Not previously seen was the Lucas 40kVA hydraulic pump and motor. This artist's impression depicts a scheme related to that illustrated in conjunction with a Rotax alternator on p. 453; note the cooling fins.

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and a magnetic amplifier in its output, and would be used in conjunction with the hydromechanical drive to provide the necessary frequency reference on a paralleled system. The voltage control units were typical of those to be used with the English Electric brushless alternator, incorporating magnetic amplifiers for the main power circuits and a neon bridge for the main sensing circuit.

Transistors are finding applications in lightly rated circuits of protection units, such as those in under-voltage and over-voltage networks. English Electric also displayed a wide range of their D.C. generators, all designed for 28V systems and rated at from 3 to 12kW.

A complete ram-air turbine-driven alternator was exhibited by **Rotax, Ltd.** The complete package, which is listed under the code of BAT.0101, weighs 75 lb and drives a 15kVA alternator at 8,000 r.p.m., controlled to within ±5 per cent by a mechanical governor mounted in the nose of the turbine. The complete package is designed for fixed installations inside an aircraft, the air supply being obtained by extending a suitable intake into the airstream. The drive has 100 per cent overload capacity for a period of up to 5 sec.

Another new Rotax development is a bleed-air turbine-driven alternator representative of a class of equipment which is becoming increasingly attractive as a means of obtaining constant frequency. The unit shown was rated at 15kVA at 24,000 r.p.m., and it was stated that the speed (and therefore frequency) could be controlled to within ±1 per cent. The complete unit weighs 80 lb and its associated voltage and frequency units together add 32 lb. Brushless alternators were also in evidence on the Rotax stand, and in each case the silicon diode has been mounted within the hollow shaft as near to the axis of rotation as possible. Both air-cooled and oil-cooled models are available, and in each case the design speed can be 6,000 or 8,000 r.p.m.

On the adjacent stand of **Joseph Lucas (G.T.E.), Ltd.**, one of the Rotax brushless alternators was shown coupled to a hydraulic drive motor. The latter is suitable for driving machines rated at up to 40kVA, and the power transmission is purely hydraulic. This type of drive has the advantage that the pump can be mounted on the main aircraft powerplant and the hydraulic motor and alternator stowed elsewhere. Both the pump and motor can readily be combined to produce an integral constant-speed package.

Bleed-air turbine-driven alternators were also shown by **Sir George Godfrey and Partners.** Their Type TGA.30 consists of a turbine running at approximately 30,000 r.p.m. geared down to a Rotax N.0305/1 alternator running at 8,000 r.p.m. The unit is capable of driving machines up to 30kVA and weighs 150 lb. Frequency control is achieved by an electro-hydraulic servo which operates a butterfly valve in the air supply to the turbine. The voltage controller is the Rotax Type U.3001 weighing 42 lb.

Yet another design of ram-air turbine was exhibited by **The Plessey Company,** and in this case a turbine-driven alternator Type TRA.170/16 is arranged in drop-out form, i.e., the complete unit is extended bodily into the airstream. Speed control is effected by variable-pitch blades actuated by a mechanical governor. It is worth noting that inlet guide vanes are employed in this unit, and they control the speed to within ±3 per cent. The weight of the package is 78 lb and once again there is evidence of co-operation, the alternator and voltage-control system for this particular drive again being products of Rotax.

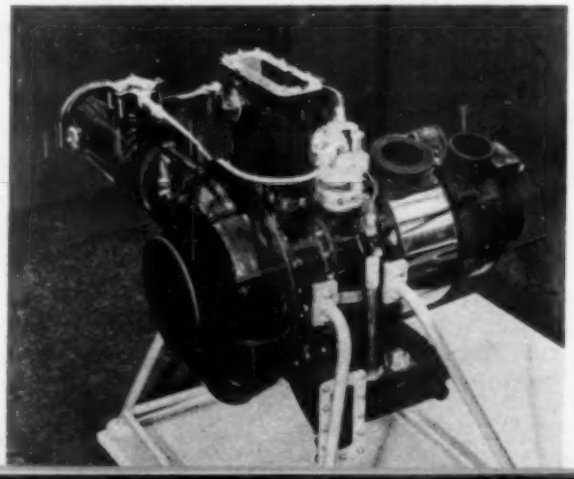
A novel 3kVA three-phase inverter was on view on the Plessey stand, the voltage controller, starting gear and contactor all being housed in a control box mounted on the inverter itself. The complete unit has an aggregate weight of 60 lb. The controller maintains voltage at 200 ±2½ per cent for all loads and power factors between 0.95 leading and 0.8 lagging. Frequency is held between 380 and 420 c/s by means of a centrifugally operated carbon-pile governor. Up to 10,000ft the unit is self-cooling, although provision is made for an additional air supply for use at higher altitudes. Yet another Plessey product is a transformer/rectifier unit weighing 50 lb and capable of handling 50kVA. Using silicon diodes for rectifiers the unit has been designed to accommodate 40 per cent overload for short periods and has fan cooling; it has been chosen for use on the Vanguard.

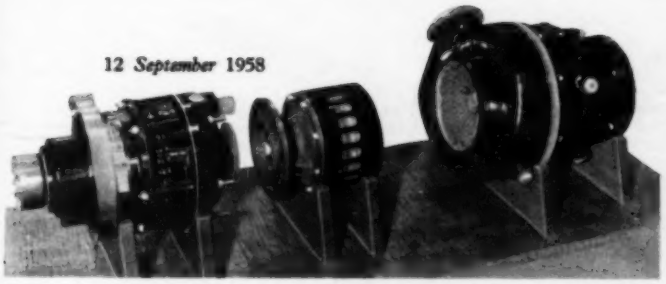
Major electrical power for the Comet has always been handled by **B.T.H.** A D.C. system is employed, the Comet 4 having four 15kVA three-phase machines generating at a line-voltage of approximately 26V and feeding into selenium rectifiers. Alternator cooling is assisted by air bled from the Rolls-Royce Avons, the operating limit being 200 deg C. Labyrinth seals are employed, the latter being fed from the Avon compressor at one stage higher than the main cooling air. The alternator has six poles, is lubricated by the synthetic engine oil and weighs 71 lb.

It was stated that the Comet's selenium rectifiers will eventually give way to silicon diodes, but the unit shown at Farnborough employs the original pattern, cooling being effected by ram-air, assisted under certain flight conditions by engine air bleed. B.T.H. say that a 30kVA brushless alternator is under development; it is intended to control this machine by a magnetic-amplifier circuit, and details are eagerly awaited.

A wide range of D.C. generator equipment was also exhibited by B.T.H. Typical is the LG.2214 2kW generator, which weighs 30 lb and is used on the Heron. This generator is controlled by a Newton Bros. carbon-pile regulator, contactor and differential relay, all mounted on one base and making a particularly compact system.

The Godfrey TGA.30 turbo-alternator, described in Col. 1.





Similar to the air turbine starters employed on the DC-8, Boeing 707 and Electra, these AiResearch units manufactured by Armstrong Siddeley should have a considerable appeal to the manufacturers of Britain's two new civil aircraft.

A.P.U.s and starters

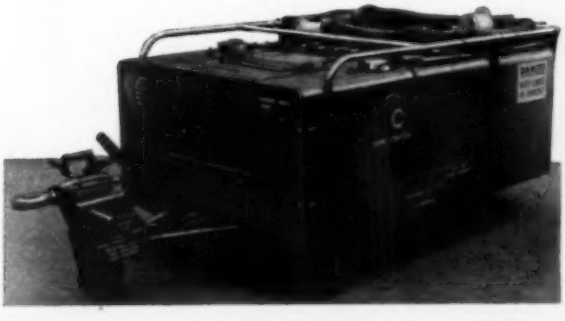
THE trend in aircraft starting—notably for civil aircraft—is clearly towards the pneumatic starter spun by air at low pressure. The supply may be from a ground truck or from an auxiliary power unit contained in the airframe; in the latter case the A.P.U. can serve a useful purpose as an emergency alternator, D.C. generator or hydraulic pump drive, or as a source of air for ground conditioning. Although *in toto* this system is fairly heavy, not all the weight carried can be charged against air starting and on a weight-for-torque basis the air-turbine starter may well be lighter than other competitive self-contained systems. It also has the advantage that it does not need to be disconnected from the engine. Where very rapid starts or re-starts are required, the cartridge or mono-fuel starter is probably to be preferred (though it is undoubtedly expensive) and electric starting has by no means yet been superseded. **British Thomson-Houston** are among those who continue to manufacture starters of both types. Perhaps surprisingly, no new starters or A.P.U.s were on view that made use of H.T.P. fuel.

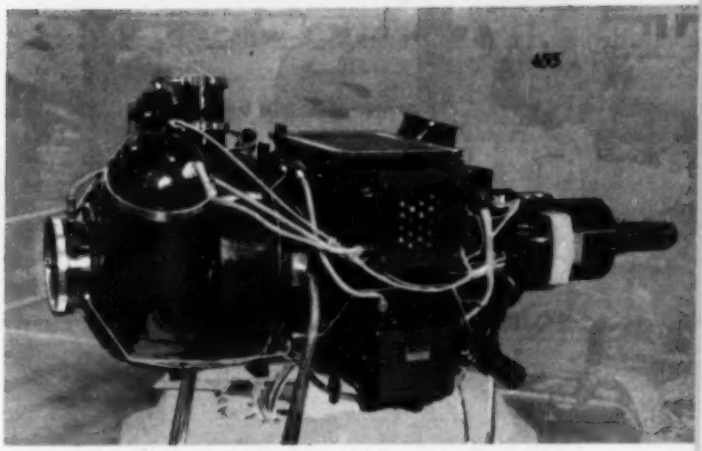
The starting systems battle continues. Starter generators have been laid aside and D.C. starting is perhaps less popular than formerly, on account of the size and weight of starter required to turn an engine of high inertia and the poor low-temperature performance. Starting by A.C. motor is, however, attracting a good deal of interest and, contrary to some opinion, ways of A.C. starting through alternators rotated by constant-speed drives are still being explored. Here again an A.P.U. must be carried if starting is to be self-contained, but the additional weight of performing the actual starting function is only 2 or 3 lb per unit.

Few of the new generation of civil aircraft will be incapable of at least an emergency start on their own systems. The Eland engines of the Fairey Rotodyne, for example, carry a new **Venner** 120 volt silver-zinc battery that measures 23in × 25in × 7in, weighs 226 lb and is capable of performing an unassisted start. Eland engines installed in the Canadair CL-66 are to be started by a Rotax CT.1008 air-turbine starter fed from a **Blackburn** Palouste 502 A.P.U. installed in one nacelle. Air is delivered at 55 lb/sq in absolute pressure at 210 deg C through 3½in-diameter ducts. The Palouste is started from the aircraft's 24-volt batteries and is provided with several drive pads for D.C. generators, 400 c/s alternators or hydraulic pumps. Advantages claimed are a weight reduction over an electrical starting system of up to 850 lb, quicker main engine starting and the possibility of performing an unlimited number of starts. The turbine runs at 55,000 r.p.m. and engages the drive through a 12 : 1 reduction gear. A typical Blackburn-Rotax system was demonstrated live at the S.B.A.C. show with a flywheel providing a representative inertia.

A way of obtaining self-contained starting without the use of an A.P.U. or storage batteries is to use air-turbine starters and high-pressure storage bottles. This system, which is in use on the Boeing 707, is advocated for some applications by **Rotax**, and a combustion chamber in the line between the bottle and starter provides additional energy from the aircraft's fuel supply. This is not the same thing as an air/fuel starter, since it can be brought into use when extra power is required; some form of re-charging system for the air bottles must, however, be provided and such highly charged air vessels must be carefully protected.

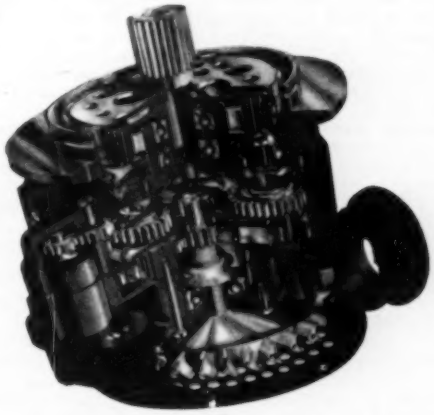
Blackburn's air starter trolley, illustrated here, was used at Farnborough to demonstrate engine starting with a Rotax air turbine starter. Containing a Palouste compressor, it is in Admiralty service.





Auxiliary powerplant for the range of starters shown above, left, is the GTCP 105 made by Armstrong Siddeley under AiResearch licence.

This Venner 120 V, 70 amp-hr, silver-zinc battery supplies power for the D.C. electric starters of the Rotodyne's Napier Eland engines.



Rotax are leading protagonists in Great Britain of air turbine starting. This sectioned view illustrates how the useful power is developed in so compact a space.

It is these considerations that have led **Armstrong Siddeley Motors** to take on the licence-manufacture of the AiResearch GTCP 105 and 100-50 auxiliary power units and associated low-pressure air starters. Some 5,000 "gas turbine compressor and power" units and 15,000 starters have already been built in the U.S.A. They have been accepted for use in the Boeing 707, Douglas DC-8 and Lockheed Electra and may possibly be used on the VC.10 and D.H.121—certainly air-turbine starters are among the units being considered. These starters, which should have an overhaul life of about 1,000 starts, are being produced in a wide range of sizes weighing between 11 and 20 lb and having corresponding variations in output of between 100 and 440 h.p. The ATS 100 series, for example, has a power output of about 90 h.p. which can be boosted to some 150 h.p. by a line combuster.

Yet another claimant for the overall lightest weight is the

Displayed in the outdoor exhibition was Rover Gas Turbines' neat airborne auxiliary power plant. Starting is either by electric motor or by the cordite cartridges visible under the powerplant.

ON THE GROUND . . .

hydraulic starter system. **Plessey** advocate this, because, they say, air is inexpensive in installation size, weight and complication. A unit built under licence from Pesco (U.S.) has been developed for starting the Orpheus. It weighs 12 lb and can spin the engine (overcoming 75 lb-ft² inertia) to lighting-up speed in eight seconds.

An airborne auxiliary powerplant already installed in an aircraft (although the application may not be mentioned) is the 1S/60 unit manufactured by **Rover Gas Turbines.** It is equally happy working as a ground unit or functioning at up to 30,000ft—an altitude which Rover are striving to extend. The gas turbine is started either by a 24-volt starter or, at altitude, by a cordite cartridge, two of which are hung underneath the unit and feed through lagged pipes. The 1S/60 is arranged to drive a **Rotax** 208-volt alternator which supplies 32kW at sea level and 15kW at 30,000ft; in addition, the gas turbine can deliver up to 686 cu ft of air per minute. The complete unit, with side panels and exhaust stack, weighs 400 lb.

Now becoming popular after some initial resistance from airframe manufacturers are ram-air emergency power units. **Plessey** have long been among the pioneers in this field and had on show at Farnborough a 15kW air turbine driven unit that is arranged to drop out from a flush housing in the fuselage if other supplies fail. A similar unit, the ram-air turbo alternator BAT.0101, has been recently produced by **Rotax.** Further notes on these units will be found in the electric-power section.

Powered flying controls

THE rapid and intensive development to which powered flying controls have been subjected in recent years has now temporarily slowed, although much of interest was still to be seen at Farnborough last week. Pride of place should perhaps be given to **Boulton Paul,** for attempting the most original work on show—the pneumatically powered aircraft flying control.

The difficulties here are twofold: to make the system "stiff" and to make it dead beat, i.e., to be free from overshoot. The former objective Boulton Paul claim to have achieved, and the surface demonstrated on their stand was certainly irreversible within the limits of its physical strength. In the latter aim, they do not (in the demonstration model) appear to have been so successful. In the absence of any information from the firm, the purpose of this system can only be the subject of speculation. There appear to be two possibilities—a very high temperature application (presumably coupled with high speeds and high surface loads) or a relatively low-speed vehicle where the stiffness of a powered control might permit a reduction in the bulk of mass balance carried. But, to date, a low pressure system such as this would seem unsuitable for the latter purpose. Reasonable stiffness can be achieved with a piston jack control by increasing the valve dead zone, but this conflicts with the need for a high gain valve to minimize overshoot. The latter cannot be adopted without careful attention to system stability. It is assumed that the Boulton Paul unit is a piston jack type, since it is incorporated within a fairly slim flying control surface, but an entirely possible alternative method of operation might be a screw jack operated by an air turbine drive. This would ensure adequate stiffness.

Also on show is a new tandem-ram flying control unit with two independent hydraulic systems supplying fluid to the patented, low break-out force, rotary valves. Should a pump fail, the unit will continue to function at reduced power. An integral part of this control is an autostabilizer actuator and the unit can readily be adapted for autopilot operation.

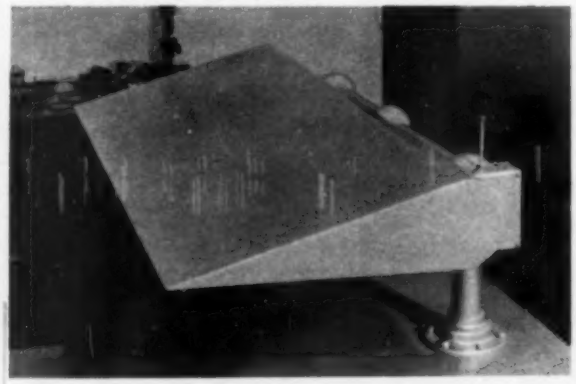
Drawings and photographs around the stand indicated that Boulton Paul flying controls are to be found on the NA.39 and will be fitted to the Vickers VC.10. The latter application is particularly interesting, since it is already known that the VC.10 is to have split control surfaces, and Boulton Paul have past experience with powered controls of this type to draw upon. Since an irreversible system is sure to be adopted, it can be assumed that feel simulators will also be fitted to this aircraft, but these will not be manufactured by Boulton Paul.

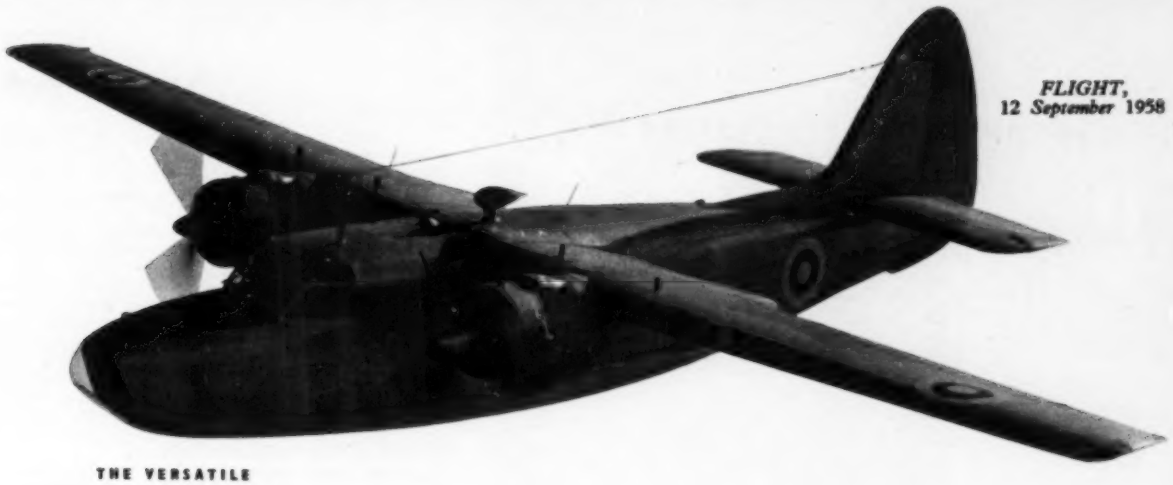
Over the remaining manufacturers in the powered flying control field, not very much that is new was on show, although several units have been quite extensively developed. **Fairey's** electro-hydraulic servo valve is a case in point; the company suggest that it has been modified and improved to an extent where it is virtually a new design. The maximum flow that can be accommodated is limited by torque motor power and Bernoulli forces. The latter can be minimized by careful valve design and the original valve, which had a maximum output flow of 0.3 gal/min, has been developed to pass six times this flow; and within six months this should be doubled again. A considerable increase is possible with two valves in series and two stage systems are now in production with flows of 30 gal/min at 5,000 lb/sq in. If required, a stabilizing term can be added by mounting an electrical pick-up on the unit. Applied to the servo loop, this permits higher loop gains without exceeding the margin of stability; on a two-stage system two such terms are available. New applications have been found in the control of machine tools and of a steel strip rolling mill; a tendency for diversification that is typical of the industry's year. Fairey demonstrated their valve in conjunction with an electrically signalled position servo and an electrically signalled pressure servo.

One of the very earliest designs of powered flying control was that designed and manufactured by Leduc Aircraft in 1932. The basis is an un-jammable multi-ball valve opened by profiled ramps on a central ram. The variation in ramp shape and ball size permits almost any response characteristic to be obtained. **The Turner Manufacturing Company** are constructing flying controls of the Leduc design in Wolverhampton; on offer are hydraulic servo controls with manual reversion, irreversible hydraulic servo controls and hydraulic, electro-hydraulic and all-electric systems to link these controls with autopilot, autostabilizer or other remote control. Leduc controls are fitted to a number of European aircraft (Bréguet 1001, Vautour, Baroudeur, Fiat G.91, Deux Ponts, Mystère, etc.) but have not so far been found on British application. Their major technical offering is the ease with which the characteristic can be changed and their ability to operate without finely filtered oil.

Finally, **Sperry** were again using the S.B.A.C. show as a time to propose an idea—in this case the integrated instrument and control system for large transport aircraft. Shown as a tabulated diagram, the system proposed fully powered controls on all three axes and autostabilization as required. A duplicate, standby autocontrol system and duplicated flight instruments are included. Typically, provision would be made for automatic flare-out.

Mystery feature on the Boulton Paul stand: the pneumatically operated control surface, with enclosed mechanism.





THE VERSATILE

Pembroke

(Powered by Alvis 'Leonides' engines)

Now in service with the Air Forces of seven nations, the PEMBROKE is rugged, dependable and versatile. The PEMBROKE is particularly suitable for the transport of senior staff officers, in which role it is equipped to carry six passengers. The standard communications aircraft carries up to twelve passengers in either forward or rearward facing seats which are quickly removable for conversion to the freighting, photographic, ambulance or supply dropping roles. Pilot training, and aircrew training for which the aircraft is equipped as a flying classroom, complete the varied roles in which the PEMBROKE can be operated. Provision is made for all these roles in the basic structure.

HUNTING AIRCRAFT LIMITED

A Hunting Group Company

LUTON, BEDFORDSHIRE, ENGLAND and at 1355 O'CONNOR DRIVE, TORONTO, CANADA

In quantity production

In quantity production for the United States Navy, Martin-Baker patent Mk.A5 and G5 fully automatic ejection seats are installed in the Grumman F9F-8T Cougar Trainer and the Chance Vought F8U-3 Crusader. Both of these seats are fully capable of ground-level ejection as successfully demonstrated at the U.S. Naval Air Test Centre, Patuxent River, on August 28th, 1957.

MARTIN-BAKER

AIRCRAFT COMPANY LIMITED

ENGLAND — CANADA

Hydraulics

ENGINEERING in the hydraulic sense advances more by application to specific problems than by basic re-thinking on the hydraulic method of producing a result. Yet there are plenty of signs that the industry is alive to better ways of designing hydraulic circuits. **Electro-Hydraulics** had pamphlets on their stand illustrating a power circuit that will meet emergency requirements without the weight penalty of duplicated hydraulic pumps. The essence of this circuit is two emergency reservoirs of adequate capacity, a flow divider proportioning their flow, and switches on the main reservoir. The failure cases governed by the system are a pump failure, leakage on the suction side of the pump, leakage in the delivery line at any point in the circuit, a component fault, return line leakage and loss of pressurization. The circuit is illustrated in the accompanying diagram.

Among the hydraulic equipment on show not designed for any one specific application were the new range of **Integral** hydraulic pumps. These are of the "churn" type and are much lighter, size for size, than conventional radial piston pumps (of the type for which Integral have long been well known) of equivalent capacity. Being servo controlled, at any pre-set constant pressure and a given speed, the delivery is infinitely variable or they can be set to give constant delivery with variation in speed or pressure. An important feature is that the output pressure can be virtually constant from maximum delivery to zero flow and for any flow within the r.p.m. parameter the pump is always operating at its maximum pressure. Integral claim a hydraulic power to weight ratio of up to 3.5 h.p./lb.

Fairey Hydraulics displayed a 3 gal/min, 3,000 lb/sq in, five micron filter, and a larger version for a 4,000 lb/sq in system that will pass 14 gal/min. **Ermeto** introduced earlier this year a simple high pressure industrial hose re-coupling unit. It consists of a steel insert and two forged saddles that interlock with it, and was shown at Farnborough along with their standard range of equipment.

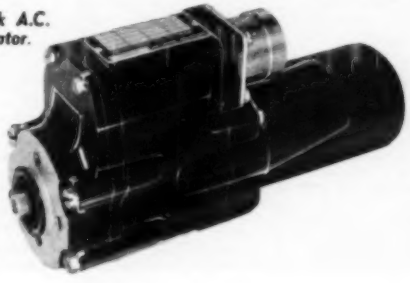
A hard anodized plug and diaphragm sealing characterize the Mk 4 **Saunders** spherical plug valve, which has now exceeded 1.5 m cycles on test. **Lucas** exhibited their successful hydraulic pump and motor, developed from many years of experience with basically similar fuel pumps. **Sperry** displayed the range of Vickers (Detroit) Aircraft hydraulic pumps and motors which are now being built under licence in England.

Electric and pneumatic units

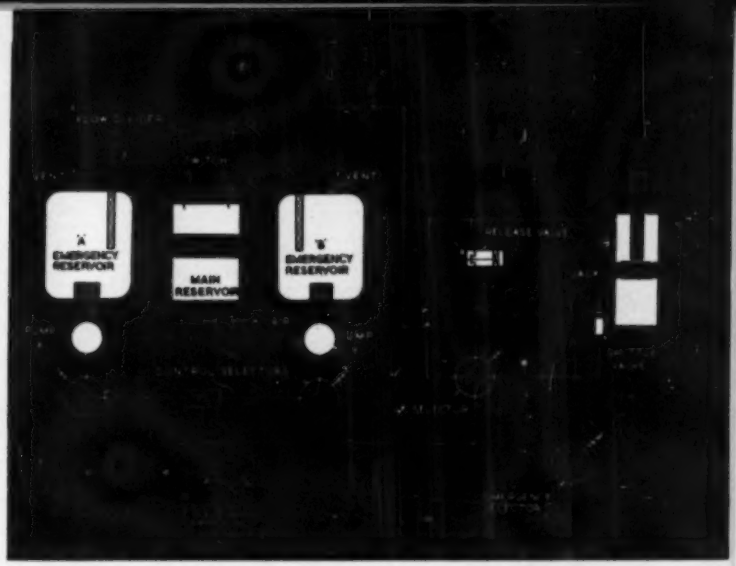
COMPONENTS that are described within this section include many of the smaller units that were on display within the static exhibition marquee. So diverse are the products of the manufacturers whose exhibits are reviewed here that there would be many exceptions in any attempt to distinguish more than a most general trend. Nevertheless, it can be noted that more A.C. components are available than hitherto and that development for tighter packaging and lower weight continues.

New from **Vactric (Control Equipment)** was a high-speed rotary switch which can be used for D.C. signal-chopping, wave-form generation, amplifier stabilization and high-speed or low-speed applications where information is sampled. A composite unit was shown embodying two 24-way low-speed switches driven through on 80 : 1 gearhead from a 6 volt D.C. motor and a high-speed switch driven at motor speed.

Plessey had an extensive range of A.C. actuators on view which included both linear and rotary models; they have been developed for 115 and 200 volt, 400 c/s three-phase systems, but 115 volt single-phase units are also being developed. The range includes Falcon, Eagle and Condor linear actuators with output loads of 80, 600 and 180 lb, and Hawk, A.C. Squirrel and Kestrel rotary machines with outputs of 40, 85 and 85 lb-in respectively. **Sperry** are producing a Size 11 A.C. motor tacho with a no-load speed of 6,000 r.p.m. and a stall torque of 45 gm cm. Two versions are available, the difference between them being only the voltage range of the control phase in the motor section. Another unit is a precision potentiometer—a compact means of achieving precise voltage division proportional to the angular position of a shaft. The rotating mandrel is helically wound with 50 turns of silver-palladium wire and the wiper is of gold alloy. Other contacts are similarly tarnish-free. Sperry suggest that the unit could provide a signal proportional to shaft rotation; and that it could be geared to a dial or counter and used in a manual self-balancing potentiometer or bridge circuit.



Plessey Hawk A.C. rotary actuator.



Philosophy from Electro-Hydraulics; a simplified representation of a lightweight power circuit that meets most of the possible failure cases.

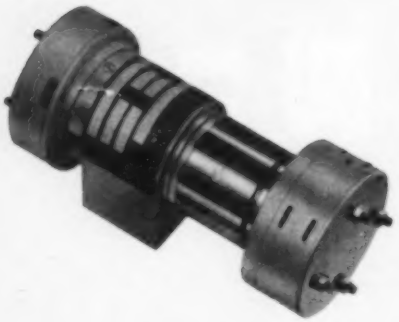
A high-pressure switch with an operating range of 0 to 5,000 lb/sq in is a new product of **Thermal Control.** Both unit and diaphragm are of stainless steel and the switch can be used in fuel, H.T.P. or nitric acid. It weighs 12 oz. The same company have developed an engine fire-detector control unit which weighs 14½ oz. It operates on the principle of rate of rise of temperature by sensing the electrical output from detector heads that are rated for 400 deg C intermittent and five minutes at 1,000 deg C. **English Electric** showed a variety of equipment which is used in their constant-frequency A.C. system—notably a frequency and load controller, alternator control panels, three-phase contactor and voltage regulator. Other exhibits included D.C. generators and fractional h.p. fuel-pump motors.

A portable cable-tester—with industrial as well as aircraft application—was shown by **de Havilland Propellers.** Each wire is checked automatically for continuity and insulation and a red light in an observation window is illuminated if a faulty cable is found, in which case the selector stops at the faulty core. Where long cable-runs have to be tested, or where two operators can more conveniently be used, an intercommunication amplifier is used and the operators are given an audible warning as each cable is tested. **R. B. Pullin** are producing "building blocks" of servo components and demonstrated them in a closed servo system to show the performance characteristics of the D.C. motors with variation of input and resulting speed control.

Pneumatic units on display were exhibited by **Gloster Technical Developments** and by **Hymatic.** Diaphragm valves manufactured by Gloster are suitable for mounting directly on to an aircraft engine; they include features to reduce the effects of temperature expansion and to prevent disc howl. Extensive flight and fatigue tests have been performed and the valve will operate at 250 deg C. The most important feature is low pressure drop; in a pressure reducing valve 2 lb/sq in at 20 lb/min is typical and in an air control valve 4 lb/sq in at 6 lb/min. Low pressure-losses can be maintained in scaled-up valves passing up to 150 lb/min of air. Hymatic's offering includes a Hydrovane compressor with a displacement of 25.6 cu ft/min at 1,440 r.p.m. which absorbs 8 h.p. and a range of pneumatic valves. An electro-magnetic stop valve and pneumatic injector and distributor valve are typical. The anti-g valve is well known in the safety-equipment field.

Landing gear

UNDERCARRIAGE development at Farnborough this year showed refinement of detail and new application rather than great advances in design. Still the only new *design* development (although it was on view last year) is the Quadricycle gear shown in working-model form by **Electro-Hydraulics** and fitted to what is obviously a large supersonic bomber or transport. This arrangement has a conventional power-steered nose undercarriage, carrying about ten per cent static a.u.w.; instead of the usual two main gears, however, there is a large four-wheeled bogie mounted centrally in the fuselage and two load-carrying outriggers in the engine nacelles. The central bogie absorbs about 75-80 per cent of the landing loads whilst the outriggers share the remainder. In this respect the arrangement is unlike the American "bicycle"



Two typical miniature components: (left) Sperry size 11 A.C. Servo tacho and (above) Vactric's new high speed rotary switch.

ON THE GROUND . . .

type of gear as fitted to the B-47 and B-52, where the outriggers take no landing load but are there only to protect the wing tips by stabilizing the aircraft during taxying. The Quadricycle arrangement is a pointer to the future as being perhaps the only method of accommodating the landing gear where the wing has such a low t/c ratio; the alternative of very large nacelle fairings to cover conventional main gears would undoubtedly produce unacceptably high drag at supersonic speeds.

Another interesting pointer in undercarriage design is the use of titanium alloys, as exemplified in a main gear exhibited by **Dowty Equipment**, in which a few parts—such as the axle and brake torque plate—are of a 55-ton titanium alloy. This material is still too expensive, however, to be worth using in place of larger light-alloy fittings, and it is very unlikely that we shall see all-titanium undercarriages for some time to come, especially on civil aircraft.

The size of light alloy one-piece forgings seems to have increased steadily over the past few years but, with available forging equipment in this country, the maximum possible dimensions have now been reached on the main undercarriage for a V-bomber. If larger presses were to be installed there is little doubt that still larger fittings would be used, since the latter would be lighter. The Britannia main undercarriage exhibited by **British Messier** is another example of the use of very large light-alloy forgings.

A cryptic, but thought-provoking, exhibit on the stand of **Northern Aluminium** was the rough hand-forging for the main leg of "a new prototype nearing completion." The material was D.T.D.683A (Noral B75S) high-strength aluminium alloy, and the company's 4,000-ton press was used to squeeze the big piece of metal into shape.

Among other undercarriages exhibited by **Dowty**—and bearing a family resemblance to the main unit for the Fokker Friendship—was the main gear for the AW.650 Argosy. The retraction geometry of this pair of units is identical—as might be expected, since both aircraft have a high wing and therefore a long main undercarriage. The Argosy is, of course, more than twice the weight of the Dutch aircraft.

Few startling new developments were apparent, but the struggle to fit ever-increasing energy capacity into the smallest possible space and weight continues successfully.

Dunlop exhibited the wheel and brake fitted to the latest Viscount, complete with Maxaret anti-skid control. It is interesting to note that the emergency energy capacity of this brake, as proved on test, is nearly double that for which it was originally designed.

Goodyear exhibited the Tri-metallic type of multi-plate brake and their proven electrical anti-skid system. Introduced early this year but, most surprisingly, not on show, was the "foot-thumper" skid-warning system, which, when mainwheel skidding is imminent, applies a vibration to the pilot's foot by means of an electrically excited button in the rudder pedal. The system is at present being evaluated by B.K.S. on an Elizabethan. The aircraft has been flown by the chief A.R.B. pilot, Mr. D. P. Davies, and Board approval is awaited of the modification of an existing pedal installation. A new development is the conversion of two Bristol Freighters—one of Air Charter's fleet and another from Silver City—to hydraulic brake actuation. The 400 lb/sq in pneumatic actuation system is retained but the air pressure is now led to one side of an air/oil ram fitted at the top of the undercarriage leg. The downstream side of this unit supplies oil at 1,000 lb/sq in to a modified DC-6 type single-disc, four-spot cluster brake. A reduction of replacement costs to $\frac{1}{4}$ or $\frac{1}{5}$ of that of the pneumatic brake is claimed, and Goodyear entertain hopes of the conversion of both the Silver City and Air Charter fleets.

Tri-metallic disc brakes, as manufactured by Goodyear, have proved very successful. This unit is fitted to the Viscount 810.

Air conditioning equipment

THIS year the emphasis of manufacturers' efforts was upon the transfer of more and more heat. In the civil field, where the volumetric pressurized capacities of new airliners are larger than ever before, the problem is to hold down equipment weight while dealing more efficiently—in terms of conditioning, pressurization and recirculation—with bigger mass flows. In the military field the comfort of aircrew and the cooling of missile equipment is presenting a stiff challenge as aerodynamic heating and the heat-outputs of electronic equipments increase.

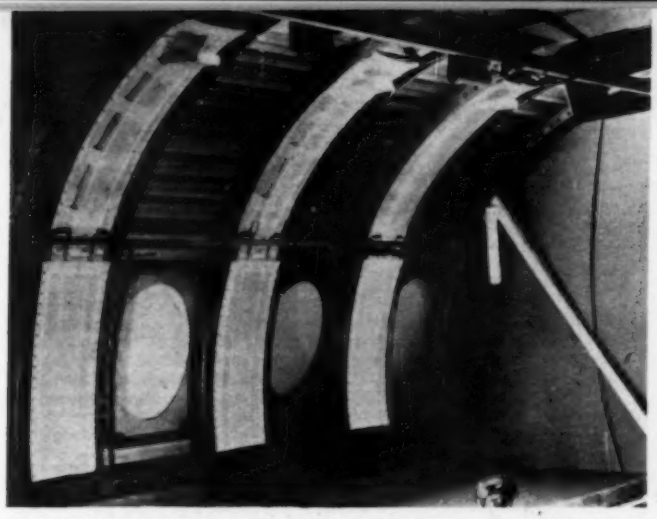
Marston Excelsior showed heat-exchangers fabricated in titanium, with obvious application to cooling systems where size (and hence weight) and corrosion are problems. **J. Stone (Deptford)** exhibited their neat Stone-Vapour thermostatic controls used for cabin-temperature regulation in T.C.A., Capital and Continental Viscounts. **Delaney Gallay's** heat-exchanger for the Dart-Herald's cabin-air system exhibited the interesting mixed application of steel and light alloy which reconciles the requirements of temperature-resistance with weight. This firm was also emphasizing its test and research facilities, which are aimed at achieving "maximum thermal and mechanical efficiency with lowest size and weight."

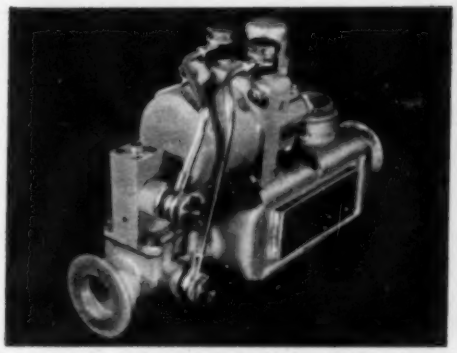
Oxygen systems for civil and Service crews were prominently shown by **British Oxygen Aro Equipment**. Liquid-oxygen systems for the Lightning, Gnat Trainer, Sea Vixen, Scimitar and Gannet have now been developed, and the firm look to "Lox" as the long-term answer—civil as well as military—to the problem of reconciling increased oxygen demand with low weight and small size. Such a system developed for passenger use in jet airliners might, the firm believe, save 200 lb weight in the Comet 4 and 200-300 lb in the VC.10 But today's jet-passenger emergency-oxygen needs, in the Comet 4 in particular, are being met by **Walter Kidde**. Special emphasis was placed on the gaseous system now being retrospectively fitted in B.O.A.C.'s Comet 4s. In the event of decompression, foam-rubber masks automatically spring from the hat-racks; high-pressure oxygen is available to every passenger for up to eight minutes, and a low-pressure supply for up to three hours. Total weight penalty is under 100 lb.

Vanguard equipment on show included an axial-flow recirculation blower by **Plannair**, and a boost fan for individual passenger cool-air louvres (which will be an essential amenity in all pressurized airliners). Also for the Vanguard, on the **Sir George Godfrey** stand, was a new electrically driven 200-volt A.C. freon compressor for use in vapour-cycle refrigeration systems. Weighing 14 lb, its refrigeration-rating is 3.8 tons, and the unit is in production for a missile application. New Vanguard equipment included a large cold-air unit, type CT-8, and an axial-fan turbine to enable the cooling system to be used on the ground.

Helicopter cabin heating and ventilating requirements, difficult in the absence of air supply from forward-facing scoops, were stressed by **Dragonair**. Using an electrically driven fan developed in conjunction with **Airscrew and Jicwood**, Dragonair showed a new combustion heater for the Wessex. It runs on the helicopter's turbine fuel, the ventilation rate being 400 cu ft/min, for a weight of 19.5 lb. The unit has obvious applications for newer helicopter developments, and may be useful in helicopter ambulance work, where the warmth of casualties is an important consideration.

New from **de Havilland Propellers** was freon-ventilated suit equipment for Service aircrew. On test in a Sea Vixen, it conditions air for the crew's flying suits by cooling engine-bleed air, separating water from it, and then reheating. The specimen shown had a 4.5/5 h.p. hydraulic drive (developed by D.H. Propellers' alternator division) and a 2-cyl piston compressor.





(Left) This air conditioning ducting for the Vickers Vanguard is by Baxter, Woodhouse and Taylor. Made in Terylene fabric, it incorporates the cabin insulation material. Each assembly can quickly be unlaced for inspection of the skin. (Right) de Havilland Propellers re-heat pack for a vapour cycle ventilated suit system.

Refrigeration capacity was quoted as two tons. Electrical drive is available also, for missile equipment-cooling applications. Also shown was a typical D.H.-Hamilton cold-air unit, of which seven types are now available.

The impressive test and research facilities possessed by **Normalair** were the subject of special emphasis on the firm's stand this year. The investigation of any cooling system—for cockpits, cabins or missile-equipment—up to Mach 3 conditions is claimed to be within the firm's research capabilities. Normalair are giving close attention to vapour-cycle systems, which they believe to be the answer to the difficulties posed by increasing heat loads. A proposal for such a system to cool recirculated air in the Vanguard is being considered.

Autopilots

A NUMBER of companies are preparing *ad hoc* autopilots for particular aircraft, though only in few cases has the application been divulged. **Sperry** exhibited the pilot's controller and a servo of their electro-hydraulic precision autopilot. **Elliott Brothers (London)** showed part of the new Mk 13, which is fully transistorized, has magnetic amplifiers and three rate-gyros; pitch, yaw and roll-axis control can be separately selected, as well as attitude-hold, I.L.S. and glide-path coupling. The Elliott Type L unit for drones, including late-model Jindiviks, senses attitude by three rate-gyros and accelerometers, and has slipping-clutch electric servos.

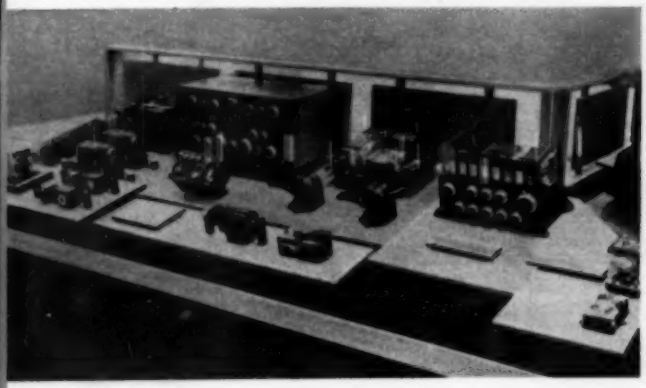
Louis Newmark showed a remarkably small miniaturized computer for a helicopter autopilot incorporating the gyro assembly. **Elliott** showed the Bendix PB-20 airline autopilot, Polar Path compass and flight director system, for which important applications are foreshadowed. A rather more comprehensive system, which is fully duplicated, is the **Sperry** integrated system using majority-vote monitoring. Both the above units can be adapted to produce automatic flare-out for the touch-down, a feature which it is intended to incorporate in both the D.H.121 and VC.10. This represents a significant step towards automatic landing.

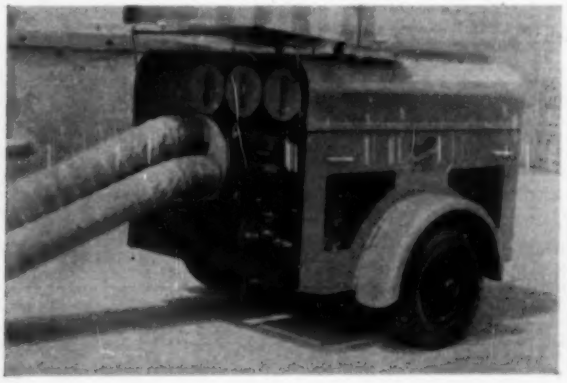
Short Brothers and Harland entered the automatic-control field with the autostabilizer for the SC.1 VTOL machine and the autopilot for the Canberra U.10. The former was described in *Flight* last week. The automatic control for the Canberra drone is a command system using tone pairs in either V.H.F. or U.H.F. bands to control a receiver relay, which initiates certain controlled manoeuvres such as turns, climbs, descents and approaches with automatic changes in configuration as required. Master controller and supervisors, with visual sights and "beepers" for azimuth and glide-path, control the landing and take-off. The "fast glide" command causes the throttles to close, airbrakes to extend and a fixed speed to be held. At about 2,000ft the descent is automatically discontinued and a speed of 153 kt assumed. The machine is then "beeped" on to the runway centre-line about seven miles out and "land glide" selected. The undercarriage extends and flap reaches full extension at 130 kt. A 2-deg glide path, visually monitored, is then flown at 110 kt and a brief burst of throttle without change of attitude achieves a suitable round-out. This latter phase is "beeped" by briefly commanding a climb. Aircraft attitude is maintained by three gyros mounted on platforms which are tilted to give various fixed deviations from straight and level. A duplicate control panel is mounted in the cockpit so that a check pilot can "fly" the machine through the automatic system while the ground controllers monitor the heading and glide-path during an approach.

Low-drift gyro systems

IN marked contrast to American practice, work on inertial navigation and guidance systems in this country is subject to stringent security classification. Until last year virtually nothing was released on British work in this field; and even then only general information became known. Yet **Sperry** have this year finally obtained permission to show the stable platform of the inertial navigation system they made and flew in a British aircraft in November 1954. The system was designed for use in manned fighters. It has now, of course, also been announced that Sperry hold the prime contract for guidance system of the British LRBM and this will most probably be inertial. In addition, Sperry are preparing to manufacture the Rotorace gyro developed by their American associates. It will be remembered that the crew of *Nautilus* considered that they could have made their polar crossing under the ice using only the Sperry C-11 compass which incorporates the Rotorace gyro. Though not of full-scale inertial quality, Rotorace is rela-

Louis Newmark helicopter autopilot components (below) include the miniature computer/gyro unit on the right of the picture. On the right is Dragonair's one therm wheeled ground heater truck, with lagged pipes for connecting to an aircraft's air conditioning system.





The Sperry "stable table" for the fighter inertial navigation system which was successfully flown in November 1954.

ON THE GROUND . . .

tively cheap and quite capable of the high precision needed for the directional reference in Doppler radars.

The instrument wing of the **Guided Weapon Division of English Electric**, following the conclusion of a licence agreement with Minneapolis-Honeywell, are preparing to produce the GG49D Miniature Integrated Gyroscope and probably some other of the well-known HIG series. The HIG.4 components were laid out on view, as well as those of the MIG and English Electric's own Mk 7 silicone-fluid damped rate gyro.

Of major significance on the English Electric stand was one of the six existing Honeywell miniature stabilized all-attitude platforms incorporating three MIGs in a four-gimbal mounting. The MIG is normally maintained at 160 deg F by an integral electrical heating element and floated in a special fluid to reduce gimbal friction. The miniature platform is, however, heated as a unit. It offers full attitude freedom, weighs 25 lb, is accompanied by a 24 lb amplifier, and uses 115V, 400 c/s supplies. Minimum warm-up time from a temperature of −65 deg F is 8 min and from +70 deg F, 4 min. The Honeywell platform can be used either as a central reference gyro or in a short-term inertial system, probably in conjunction with a star tracker or Doppler radar.

Five years ago **S. G. Brown** produced, in collaboration with R.A.E., the Master Reference Gyro Mk 1. It was distinguished by having only two gyros, a feature which has now been copied by the major American manufacturers of this type of equipment. The MRG A.5 and other models are now in full production and being supplied for use in several types of British Service aircraft. Their purpose is to provide attitude and heading signals in the form of electrical outputs for roller-blind instruments, autopilots and related equipment. The Mk 1 MRG has now been joined by the Mk 2, a remarkable development about which little has yet been released. The Mk 2 is to enter military service by the end of this year. It weighs 20 lb and is only 6½in in diameter; and one might assume that it benefits from a recent S. G. Brown/Kearfott agreement on the use of the latter company's know-how in floated, inertial-quality gyro techniques. Though it might be suitable as a short-term inertial reference it is only stated that it can provide signals for monitoring an autopilot and for heading and attitude displays.

The **Weapons Research Division of A. V. Roe** last year displayed a test rig for an advanced missile autopilot system and this year showed an air-launched test vehicle for the Avro stand-off bomb. This year, too, the Avro stand included an advanced test apparatus for the precise evaluation of low-drift rate gyros. The rotating table on which the gyro is mounted is normally accurately aligned with its axis in the vertical plane through the local meridian. Among the necessary supplies and monitoring equipment is a tuning-fork stabilized 400 c/s supply and a heater control circuit holding gyro temperature to within ±¼ deg C of the required value. The wander of the gyro is accurately measured by an optical system and recorded by an electric typewriter. It seems probable that this work with low-drift gyros is associated with an inertial guidance system for the stand-off bomb.

Special test tables for low-drift gyros were also once again exhibited by **Graseby Instruments.** This equipment has been used satisfactorily by Massachusetts Institute of Technology, one of the acknowledged world authorities on inertial systems.

Instruments

NO great novelty was apparent in the flight instruments displayed at Farnborough this year, although significant advances along established lines have been made. It is noteworthy that **Kelvin Hughes** have reverted to dial presentation of vertical speed and altitude quantities in their Flight Data System.

Elliott Brothers (London) exhibited a new version of their air data computer. It is designed for unspecified high-speed aircraft and has been completely re-engineered, reduced in size and made more accurate. It will supply information on all quantities derived from static, pitot-static and temperature transducers for tape instrument systems and other airborne equipment. Representative outputs are from Mach 0.3 to 3.0, up to 100,000ft altitude and up to 100,000ft/min rate of climb or descent. True airspeed can be shown between 200 and 1,600 kt.

Computers and simulators

A NOTABLE feature in the computer field was the introduction of at least two types of miniature electronic analogue computers suitable for desk-top or office use. **Louis Newmark** are marketing the desk-top analogue computer produced by the Donner Scientific Company of California, U.S.A. On the exhibition stand one of these machines was set up for investigation of aircraft lateral damping for studying autopilot characteristics. Newmark are also producing a line of simple and cheap electronic test equipment including a "go/no-go" phase meter for use by unskilled personnel; a low frequency oscillator for between 0.1 and 100 c/s was also shown.

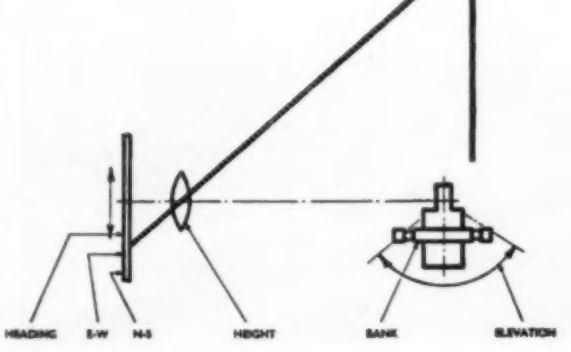
Solartron exhibited the Minispace TY 864 which is completely self-contained with its own power supply, but capable of expansion. It has ten drift-corrected D.C. amplifiers with all input and feed-back components, potentiometers, control panel and patch panel. **Air Trainers Link** were also exhibiting their mechanical analogue computer kit, yet another application of this ingenious concept.

Among the great number of computers with specific equipment applications was a calculator by **B.T.H.** designed for mounting in a cylindrical container. Its forward face carried a time-control with which bomb doors could be automatically opened and shut for a length of time varying between one and about a score of seconds.

Aircraft simulators, type trainers and procedure trainers with a variety of computers and with fixed or moving bases are finding ever wider application in both airline and military training. In this connection **Air Trainers Link** showed a model of B.E.A.'s simulator facility at Heston containing simulators for Viscount 802 and 701, Vanguard and Comet 4B. **Redifon** exhibited the controller's console of their small-area track recorder which they have standardized for all their simulators. Radio facilities can be quickly and easily set up on this; and a pen recorder traces aircraft movements on a quarter-million scale map. A graph-type final approach recorder allows an operator without special training to give the trainee pilot an effective G.C.A. with a permanent record of the trainee's performance.

Both Air Trainers Link and Redifon are working on methods of simulating the pilot's view from the cockpit, but delay in producing such systems is apparently caused by lack of orders. Nevertheless, the problems involved are considerable; and it is the **R.A.E. Instruments and Air Photography Department** which

Layout of the R.A.E. pilot's view simulator. The landscape plate is at left, the television camera at right. A blank sky is included at the top and blended with a curve into the projected scenery.



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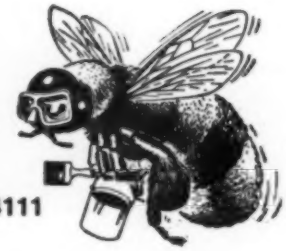

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OVERSEAS REPRESENTATION THROUGHOUT THE WORLD

has this year shown the pilot's view simulator which promises well both from the point of view of space-saving and simplicity. It involves the visual projection on to a screen of either a pattern of night flying lights produced by 0.004in holes drilled in aluminium plate or an air photograph transparency printed on Pyrex glass. The model is moved by servo motors in accordance with speed and heading signals derived from the simulator, and the pilot's view is produced by a closed-circuit TV camera mounted to photograph the projected image at a fine angle, thus producing the correct perspective illusion. The camera itself is tilted and rolled to reproduce bank and pitch attitude changes; and a zoom lens in the projector produces apparent change in height above ground. Problems still to be overcome are those of camera size and servo motor accuracy, the present photographic image embracing an area of 25 mile radius. A considerably larger area represented on a transparency of the same size raises servo motor problems. The quality of the TV camera is all-important, and R.A.E. are seeking a compromise between the cheap and effective Pye industrial equipment now being used and the much more elaborate, very expensive equipment used by the B.B.C. For the simulation of scenery at very low heights—for helicopter training, for example—solid models are necessary; flat image plates will not serve.

The pilot's view simulator had a **Pye** TV camera, a zoom lens by **W. Watson and Sons**, a Xenon arc by **B.T.H.** and computing elements by **Solartron.** Possible applications for this equipment were for training and research. In the latter context it is noteworthy that the Redifon small-area track recorder is being used by the Austrian Government to find suitable locations for radio aids. Such a method is safer than actually flying and risking an inadvertent crossing of the Iron Curtain.

Processes and materials

AN enormous number of exhibits in the static show fall within this category; more stands than ever before were devoted to displays of new materials and new methods of turning them into aeronautical products.

In spite of possibly reduced overall enthusiasm for titanium—now considered by the American aircraft industry, at least, to be not quite a "wonder metal"—the fact remains that it is today in full production and regular use. We have many times reported on its advancing technology, both from the viewpoints of extraction and utilization. At Farnborough, among many titanium items on view, were the mighty jet-pipe shroud for a Britannia, made by **Joseph Lucas,** and the intricately fabricated supercirculation blowing duct for a Scimitar, produced by **J. R. Bramah** in I.C.I. Ti-130 alloy. More titanium work—jack bodies and banjos—was demonstrated by **Electro-Hydraulics.**

I.C.I. Metals Division showed a two-ton titanium ingot as well as Kynal aluminium roll-welded heat-transfer sheet and copper or aluminium "tube-in-strip". **Marston Excelsior** exhibited Portolite tanks made from a sandwheel of fabric and rubber, and **Precision Rubbers** a new range of Prescolastik silicone grades and a new rubber called Viton A. Convoluted pipes in stainless steel were exhibited by **British Refrasil** and **Delaney Gallay** were another manufacturer to remind visitors of their skill with this material. **Sankey** were expounding the Mercast frozen-mercury process of investment casting and **Napier**—apart from their Spraymat techniques—the Napiercast lost-wax process. A new grade of the Nimonic series of high-temperature alloys—Nimonic 105—was announced by **Henry Wiggin,** and I.C.I. stated that they will shortly establish the first plant in Europe for producing wrought beryllium.

Plastics were shown in quantity: Mhoglas by **Hunting,** pre-impregnated reinforced materials by **Aeroplastics** (a subsidiary of Fairey) and new **Fibreglass** decorative fabrics. **Coin Insulation** showed laminated plastics suitable for many industries, **Microcell** glass-fibre rocket launchers and **Airscrew and Jicwood** new fans.

Metal-forming facilities were emphasized by **A.W.A.** and machine tool control by **Hymatic** and **Ekco. Sperry** have entered the non-destructive testing field with the Introview flaw-detector.

Personal equipment

A COMPREHENSIVE range of survival equipment in the form of inflatable life jackets, baby cots, escape chutes, dinghies and rafts was shown at Farnborough by **Elliot Equipment, R.F.D.,** and **Frankenstein.** Military equipment of this particular kind was conspicuous by its absence.

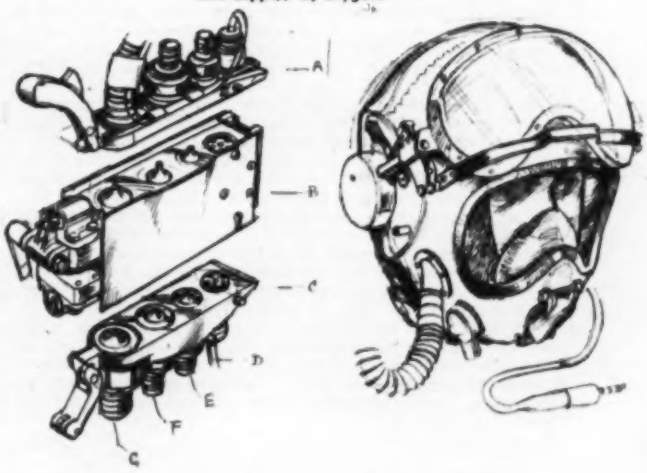
A certain amount of parachute, partial-pressure and ejection seat equipment was displayed; and it is evident that development of a full-pressure suit is sufficiently far advanced to be covered by security. Full-pressure suits previously exhibited by **Siebe Gorman, Frankenstein** and **G.Q.** have been experimental models and none of them was exhibited again this year.

Bakelite moulding of the radar nose-cone of Thunderbird.

G.Q. displayed a plastic parachute container for the Spectre A.T.O. pack for Vulcan and Victor. The same company exhibited their suit with built-in harness, emergency oxygen, Mae West and Sarah beacon. Their Mk 26A back-type parachute with survival pack and oxygen supply has a 24ft flat canopy and is being produced as a standard passenger parachute for the Royal Navy. **Irving Air Chute** showed the seat-type ES62/1 parachute now standardized for the Canberra ejection seat. It has the barometric power unit B/2 which ensured a safe descent for the crew of the R.A.F. Scorpion Canberra who ejected at 65,000ft recently. **Martin-Baker** have produced a new Canberra ejection seat fitted with certain Mk 4 components which will allow safe ejection from a minimum height of 600ft. The pilot falls free without the seat.

A remarkable achievement, in view of the American preference for home-produced equipment, is the fact that Martin-Baker are themselves making all the A5 and G5 ejection seats respectively destined for the Grumman F9F-8T and Chance Vought F8U-3. These have the 80ft/sec telescopic gun with three charges and a reinforced head-rest designed to penetrate a closed canopy. They are stressed for 40g forward load during crash landings and carry American survival packs. The standard drogue mechanism is employed with 1¼ sec time-delay between ejection and first drogue release. This allows safe escape at ground level; and a bob-weight and interrupter cam automatically prevents the time delay from releasing the drogue until the deceleration on the seat is sufficiently low to allow safe parachute deployment at very high speeds. The interrupter operates at over

Below right, the M.L. partial-pressure helmet with automatic visor open. At left is the combined services connector: A, man portion; B, seat portion; C, aircraft portion; D, intercom; E, g-suit supply; F, ventilated-suit supply; G, oxygen.



A selection of the many specialized vehicles exhibited in the outdoor static display.

ON THE GROUND . . .

4g. The parachute remains in the seat and the man wears a separate harness which he attaches quickly to the seat when he enters the aircraft. A snubber on the shoulder strap "lean-forward" reel automatically locks the harness against additional forward movement. Leg restraints are fitted and the emergency oxygen bottle is carried on the seat.

A new item is the combined services connector fixed to the seat. Oxygen, emergency oxygen, g-suit, ventilated suit and intercom leads from the pilot are concentrated on a single plate which can be quickly clipped to the connector, automatically opening self-sealing valves. It is so arranged that unless all tube connections are properly made the intercom system will not work. A similar plate connects all these supplies from the aircraft to the underside of the connector. A lanyard ensures that all pipes are cleanly broken as the seat leaves the aircraft on ejection. The combined harness and this connector save a great deal of time during the strapping-in process.

Folland showed a version of their Type 4 seat destined for the Gnat Trainer. This, too, has an 80ft/sec telescopic gun, but is actuated by a single cartridge. The complete firing unit is enclosed in the head-rest. Both parachute and harness remain in the seat and include lap, shoulder and vertical restraint straps and clip-on leg restraint with conventional snubbers, all combining to join at a four-point release box. A single pilot's supply tube carries main and emergency oxygen and intercom leads, fastened by a single bayonet coupling to the aircraft supply. One second after the seat leaves the aircraft additional cartridges are fired to actuate the three Bowden cables releasing face blind, leg- and seat-harness. A static line arms a barometric parachute release and opens two 3ft drogues in tandem to stabilize the body during free fall. The main parachute canopy is a G.Q. 18ft 6in lightweight unit, the pack for which also contains the barostat and emergency oxygen. The free fall is made at 100ft/sec down to 10,000ft whereupon the drogues extract the main canopy in a sock to ensure gentle opening. Ground-level ejection will be possible.

A new type of pressure-breathing oxygen mask called Type P and produced by **Adams** is now being standardized in the R.A.F. It rests on the chin instead of wrapping round the face and is much more comfortable and lighter than the American A13A. **Airmed** also exhibited the Type M Mk 2 pressure-breathing mask designed for use with a pressure waistcoat and resting on the chin. Airmed are already well-known for their flexible-toggle oxygen mask and lightweight headset for airline use.

The standard British partial-pressure clothing consisting of the jerkin and g-suit is much more comfortable than the American close-fitting garment. **Hymatic**, in addition to producing a combined services connector, exhibited new versions of the standard g-suit valves which incorporate a pressure-sensitive element designed to inflate the g-suit for partial pressure use as soon as cabin pressure drops below a given level. Thus the g-suit is filled with air and not with oxygen when partial pressure is applied.

The most difficult item in partial-pressure clothing is the helmet. **G.Q.** make a cloth lace-up unit with a fixed vizor, while **Baxter, Woodhouse and Taylor** and **M.L. Aviation** make helmets with automatically closing plastic vizors set on a protective plastic shell covering the forward part of the head and chin. For the Taylor unit, cabin pressure failure automatically causes the oxygen supply to turn to full pressure. This inflates a bladder inside the helmet to release a catch and allow the vizor to slam down automatically into the locked position. The feeding hole can be sealed and locked while the front part of the face is pressurized with oxygen; and a lanyard at the back of the helmet allows the wearer to unfasten the zip and heave the helmet off in one quick movement. The seal around the face is formed from a single sheet-rubber moulding, ingeniously fabricated; and this portion has to be specially made to fit each wearer.

Taylor helmets have been supplied to Avro, English Electric, Gloster, Armstrong Siddeley, Armstrong Whitworth, Fairey, Folland, Bristol, Rolls-Royce, D.H. Propellers, D.H. Christchurch, Saunders-Roe, Martin-Baker and to many Ministry establishments.

The **M.L.** partial pressure helmet is broadly similar to the Taylor unit and incorporates a plastic shell over the forward part of the head, a food port, automatically closing vizor and built-in tinted sun-shade. It has been fully approved for R.A.F. use; and M.L. exhibited an ingenious test chamber for the helmet.

Turner Leduc, who have the French Leduc licence, showed diagrams illustrating the jettisonable escape capsule applied to the Leduc ramjet fighters. It is hydraulically ejected, stabilized by retractable fins and a drogue chute which subsequently deploys a large extractor parachute and then three supporting parachutes. The pilot rides the capsule right down to the ground, sealed within the normal cabin atmosphere and lands at a rate of descent of 20 to 25ft/sec.

Outdoor equipment exhibition

"OPERATIONAL SUPPORT" equipment formed the major participation in the outdoor exhibition of products which were too bulky for accommodation indoors. First item to catch *Flight*'s eye was the blue insignia of Pan American World Airways—unexpected at an S.B.A.C. display—emblazoned on **Edghill's** Autostair Mk II self-propelled airline steps, electro-hydraulically adjustable over a range of 100-140ft, mounted on an Austin truck. The first item to catch the ear was the **Blackburn** (Turboméca) air-starter trolley, a low-pressure unit whose small Palouste turbine has been acceptably well silenced. Also shown by this firm was the Turmo 600 as installed in the Blackburn-Houchin 200-kW turbo-alternator set for emergency airfield lighting. Ground-handling cradles for the D.H. Firestreak and Bristol Bloodhound missiles were shown by **M.L. Aviation**. Reinforced-plastic multi-tube, 2in rocket-launchers, as supplied for the Sea Vixen, Lightning, Scimitar and Javelin, were shown by **Microcell**, and one of the world's biggest vacuum cleaners, a yellow-painted runway monster by **Zwicky**, is likely to be much in demand to reduce the debris ingestion problems of the podded-turbojet airliners. The model shown can clean 72,000 sq yd/hr at 12 m.p.h.

Morfax, noted for their maintenance stands, exhibited a mobile unit for the Rolls-Royce Tyne turboprop, and an elevating platform for maintenance access to a vertically positioned Rolls-Royce Avon turbojet. **Pyrene's** latest crash tender, the Mk VI (Alvis F.V.651) was shown, capable of a 5,000 gal/min foam output. "Foamite" crash tenders by **Tecalemit** typified the range of vehicles offered by this firm. From **Rellumit** at the show for the first time came a mobile refueller, appearing in Shell colours, to solve the problem of over-wing filling at airports fitted with underground hydrant systems. Operable by one man, and fitted with an adjustable ladder, it provides the necessary link between the top-surface filler cap and the fixed fuel hydrant connection on the ground. Mobile Lox tanks, varying from 50 U.S. gal to ten times that capacity, were displayed by **British Oxygen Engineering**, as a mobile gaseous oxygen producing plant. **Kelvin Hughes** had a working display of their rapid processing photographic projector (described last week and on p. 451-2).

The **Martin-Baker** ejection-seat trainer, now used in ten countries, was a dominating feature of the outdoor exhibition, competing in height with the **Jones** crane (which had put "the majority of heavy exhibits in the show in place.") A big 26-man life-raft, the **Beaufort**, fabricated in Terylene synthetic fibre coated with Neoprene synthetic rubber (giving rotproof qualities) was exhibited by **Frankenstein**. Packed, it weighs 120-125 lb, measures 38in by 26in by 10in and incorporates a self-erecting fluorescent canopy. **Delaney Gallay's** selection of lightweight, hermetically sealed jet-pipe insulation blankets included one—for the Tyne figure-eight-section pipe of the Vanguard—claimed to be the largest production blanket in the world; very thin material gauges and provision for the disposal of accumulated fuel were features emphasized. The "Turbo-Taskmaster" tractor was shown by **David Brown** fitted with the Red Devon aircraft starter unit; and **Simmonds Aerocessories** displayed their mobile Fram water separator, which filters down to five microns water and solids from any kind of aviation fuel. **Lucas-Rotax** showed some of their range of test-rigs for the overhaul and test of fuel and electrical system components; this firm displayed also a complete mobile aircraft heater trolley.

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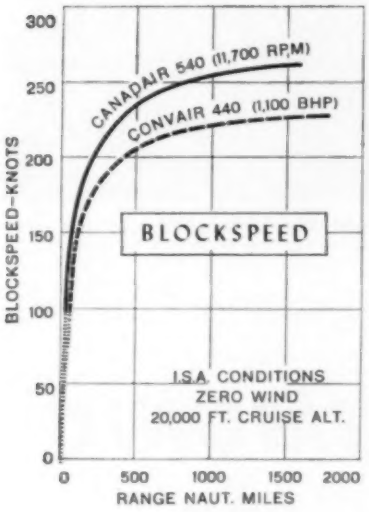
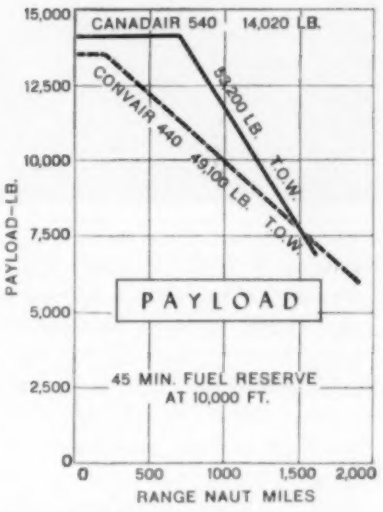


Graph at left shows the significant improvement in speed available in the turbine-powered "540" compared with the "440"—as much as 34 knots at a range of 1000 nautical miles.

Graph at right shows that the earning potential of the "540" is greatly increased. It is capable of carrying 48 passengers, plus their baggage, plus 4210 lbs. of cargo (total payload: 14,020 lbs.) a distance of 680 nautical miles. This represents a payload increase of 365 lbs. over the "440", and a range increase of 500 nautical miles.



Furthermore, with its Napier Eland turbine power, the "540"s max gross weight is increased 4100 lbs. over the "440" (up to 53,200 lbs.) . . . and the "540" can reach cruising altitude of 20,000 ft. in half the time (15½ mins. vs. 35 mins.). The "540" builds on the well-known and excellent record of the "440", and is altogether a new airliner unsurpassed in performance characteristics and earning power.

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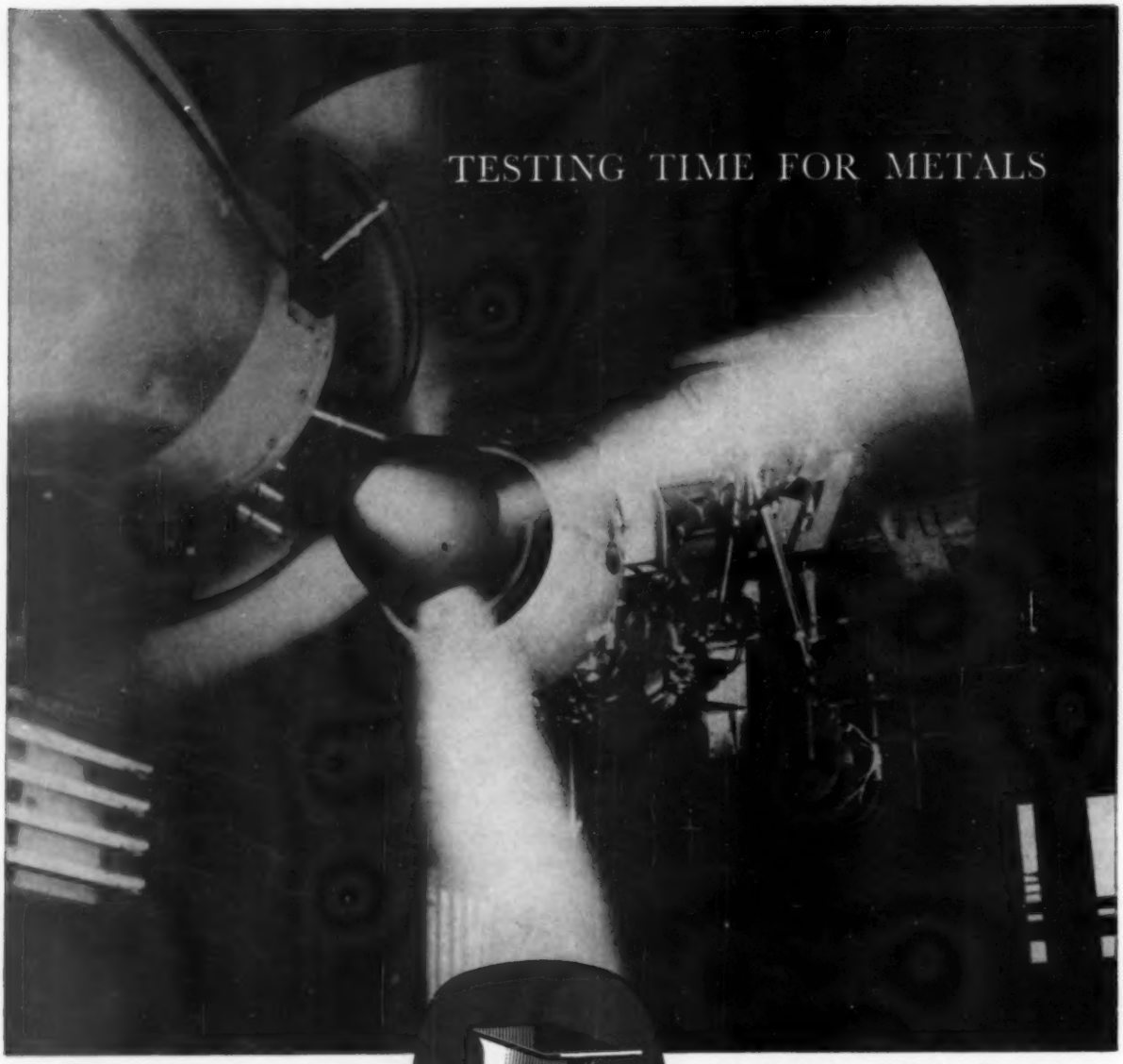

Development testing of a Rolls-Royce Tyne engine.

Progress in turbine engines calls for ever higher operating temperatures and creates incessant demands for more advanced heat-resisting materials. These demands are being met in every British aero gas turbine by the Nimonic Series of Alloys which retain great strength even at red heat. In the Tyne turbo-prop, which is to power the new Vickers Vanguard airliner fleet, Nimonic Alloys are specified for the turbine rotor blading and many other parts in contact with the hot gases.

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The Flying Display Dinner

S.B.A.C. ENTERTAINS ITS GUESTS

WHEN the S.B.A.C. Flying Display Dinner was held in London on September 1 (as briefly reported in our issue last week) the Minister of Transport and Civil Aviation, Mr. Harold Watkinson, said that although he had personally never bought an aircraft he was currently responsible to Parliament for about £150m to be spent on the purchase of new aircraft for B.E.A. and B.O.A.C. over the next few years. He said that both the two corporations and the independent operators were planning for an air world that was going to go on expanding at a high rate—and they were right to do so.

The Ministry of Transport was also an airport operator "in a fairly big way." It had just finished spending over £7m on Gatwick Airport, had committed £5m to new radar and electronic equipment in this country to meet the control problems set by faster and higher-flying aircraft, and at L.A.P. were just beginning the construction of the new long-range terminal. Against this background, the Minister said, he wished to set the passenger aircraft of the future. Its ideal requirements might be summed up by two words—versatility and flexibility; and in the range of British passenger aircraft shown at Farnborough, those requirements—and ones of range, performance, silence and so forth—were perhaps better met than anywhere else in the world.

Mr. Watkinson, who was responding to the toast of the guests, made a particular reference to silencing. It was in everybody's interest, he said, that the introduction of passenger jet aircraft should be smooth; it was important that manufacturers should do all they could to silence their new jets so as not to cause intolerable disturbance and distress to many people.

As an example of what could be done, B.O.A.C. had been operating Comet 2s from L.A.P. for many months without complaint. "Now we look forward," said the Minister, "to the arrival of the Boeing 707 for noise trials and the Tu 104 for tests of the new operating techniques which I understand the Russians have developed in an effort to cut down the noise level."

Diversity of Type

Again stressing versatility and flexibility in passenger aircraft, he said that new types must be tailored to meet stringent and diverse requirements which would not get less exacting as time went on. Other klnds of transport, he added, supported a much great diversity of type and service than had so far been available to the air traveller. There was no reason why both propeller turbine and straight jet should not live side by side; they both had a contribution to make and if judged by the yardstick of versatility and flexibility might well be more nearly matched than some thought.

It was, however, of little value to have such excellent aircraft as the Vanguard, VC.10 and DH.121 in the industry's future shop window if the customer could not afford to buy them. It was therefore of the utmost importance to the aircraft industry that the airlines should get more profit into their operations. He did not for one moment say that the airlines were at present inefficient—costs of capacity ton-miles had continued to fall in spite of rising costs elsewhere; but he felt we had not paid enough attention in the past to the necessity of earning sound profits out of airline operations. Only in that way could the future of the industry be assured.

Now that aircraft performance had reached such a high level, he hoped that the airlines could study more closely the economical life of aircraft types that give the public a good service, before they considered replacing them. In particular this might apply to the massive investment in subsonic aircraft that is to come before we get too involved in the supersonic. Since it seemed likely to cost thousands of millions of pounds to breed the next generation of civil airliners, perhaps it would be wise to make the most of the generation now coming into service.

The Minister said finally that the Government would do all that it could to help both the aircraft industry and the airline business; in particular it could continue to sponsor research both in its own establishments and by financial contributions to the research which the industry itself is undertaking.

Guests at the dinner, who numbered over 1,000 and included one lady, Miss Jacqueline Cochran, president of the F.A.I., were welcomed by Mr. A. F. Burke, president of the S.B.A.C.—whose initials, he said, also stood for "Selling British Aircraft Continuously." Last year's export figures showed a 1,000 per cent increase over those for 1946; it looked as though the total figure for 1958 would be over £150m; and since export sales were reckoned to be bringing in £300 every minute of each day and night, Mr. Burke ingeniously reminded his hearers that £9,000 worth had been exported while they were demolishing their grouse.

Government Orders

He went on to underline the serious fact that the industry could not afford to sell its customers the goods at the prices they paid, were it not for the substantial orders it received from the military services and state airlines. The industry relied on them for operational information, production orders, initial proving, and for effective operation and demonstration of the aircraft's qualities. He said that the initial proving period was the most anxious, expensive and difficult time, especially when a pioneering job was being tackled; and the whole burden of this had been borne by the aircraft industry of this country for the past ten years.

As the volume of military business fell off, all eyes were turned towards commercial aircraft, and this side of the business was being embarrassed by the weight of technical strength suddenly brought to bear on its equipment and operational requirements. It was because of this increasing interest in civil aviation that the Society had asked Mr. Watkinson to be its guest of honour.

We had spent 50 years and a vast sum of money, said Mr. Burke, in developing aeroplanes as an instrument of war. What if the same amount of time and money had been spent on civil aircraft? When the Minister of Supply announced recently that, even though fewer manned aircraft would be needed for military purposes, aeronautical research would continue on broadly the same basis, this was a far-sighted and wise decision. In the industry it was almost impossible either to keep or protect trade secrets, and for this reason it was unlikely that companies would embark on major research and development projects as private ventures. Certainly they could not afford to do so out of the profits resulting from the sale of transport aircraft at the prices and conditions now prevailing. But with so large potential gains to be achieved from technical advances such as the R.A.E. automatic landing system, there could be no doubt as to the value of continued steady expenditure on research and development. But the manufacturers must be careful not to pursue the goal of improvement in operating to the last fraction of a penny at the expense of safety; their aim should be the continued progressive improvement of the high standard already achieved. Progress along these lines would bring air travel within the financial reach of millions more people.

If we could reach an international agreement whereby hundreds of thousands of children could be flown to foreign lands every year on a scholarship exchange scheme, the aeroplane could do more over a period of 25 years towards promoting world peace than had been achieved in the past 50 years. Such a scheme was done now on a very small scale and there was evidence that it generated good will. Though no politician or diplomat, Mr. Burke confessed in conclusion, he commended the idea to his audience.

HISTORY ON THE MOVE

DETERMINING the whereabouts of historic aircraft in this country is a task for the most persistent historian; a surprising amount of changing hands takes place and very few records are kept. Those who have noted "Science Museum, West Byfleet" against such types as the first Hill Pterodactyl, Avro 504 and C-24 Autogiro may be interested to know that these and other largely unrestored aircraft belonging to the museum are being rehoused in new storage quarters at Knockholt, near Biggin Hill, and at Sydenham.

A glance around the West Byfleet hangar on a week-end just before the move took place revealed some fine specimens of early aircraft and engines. A 35 h.p. Green, copper water-jacketing and off-take pipes still gleaming (although nothing at West Byfleet is on public show), immediately caught an eye already intrigued by the co-axial push-rod design of this engine. Nearby were the car of the Beta airship (in rather sad shape), the dilapidated hull of the Curtiss seaplane *Eleanor III* (which carried out the first exploration of the upper reaches of the Amazon) and an in-line six cylinder, 12-exhaust-valve aero engine that is believed to be a Fiat. Most of the remaining exhibits, although dismantled, are in very fair order, while the Avro 504, rebuilt by the Avro company, is in magnificent condition and could apparently be made airworthy without great difficulty. The H.P. Gugnunc (Mongoose II) G-AACN is in a condition that vintage and veteran motorists would call "ripe for restoration." So is the Douglas-engined Flea G-AEHM, while the Cierva W-2 and G-ABLM, the C-24 Autogiro, could quite easily be restored to become non-flying exhibits, as is the intention of the Science Museum.

Straight and Level

"DESTROY the old and buy the new," declares Capt. Eddie Rickenbacker, chairman of Eastern Air Lines. "That is the key to progress. Today I would not take a piston-engined airplane as a gift."

Until the C.A.B. ruled otherwise Capt. Rickenbacker depreciated his fleets over four years with five per cent residual value—and he still declared big dividends. Which is quite a smack in the eye for the "slow-down-the-re-equipment-rat-race" pundits, who include myself.

Still, Capt. Eddie is an exception. I remember looking inside the Electra mock-up at Burbank, and asking whether airlines would sell the seats in the lounge. "Oh no," replied my Lockheed host. "But you can bet Eddie Rickenbacker will."

● According to one of my motoring friends there are more pre-1939 cars in Britain than in any other country in the world. I was surprised to learn this, but I had striking confirmation of it last week during a visit to an aero-engine manufacturer. From the window of one of the senior executive offices I counted 29 elderly vehicles out of a total of 48.

● "Let us face the situation squarely," writes the general manager of Aer Lingus in his company's staff magazine. "The total number of passengers—all carriers, both sea and air—travelling between Ireland and Britain showed no increase over the previous year."

This statement is aimed at explaining the drop in Aer Lingus cross-channel traffic from 433,000 to 404,000 passengers. Yet according to the only official figures available—those of the Board of Trade for the calendar year 1957—total traffic rose from 1,900,000 to 1,931,000. This sounds very little, but while sea traffic only rose by 4,000 passengers, air traffic rose by seven per cent from 418,000 to 447,000 passengers. As Mr. Dempsey says, "Let us face the situation squarely."

● Fascinated by reports of the bargains offered by those whose business it is to dispose of surplus aircraft equipment, an acquaintance recently visited such a company's store.

In shelves and bins and racks were nuts and bolts and screws and washers and landing lights and wiring looms, springs and collets, window latches and pulleys, tab washers and cockpit covers, and a hundred and one Useful Things. But, much to his surprise, what first caught his eye was a brand-new piece of hydraulic equipment that he had designed four years before. Though insignificant in size, it had been troublesome and expensive to develop, and the aircraft company that bought it paid not a whit less than £250 for each painstakingly assembled unit. Now it was for sale to anyone who wanted it for a tentative 12s 6d—the maximum residual value of a piece of equipment that had been put out of date by later modification. In fact, no one wanted it at all, and the firm that made it had been glad to sell it as "surplus to requirements" for what it would fetch as scrap.

Even my acquaintance, though full of sentimental feeling for his brainchild, had no use for it, although he helpfully suggested that a small part of it might make a good reducing valve for anyone who was prepared to run it on D.T.D. 585 oil filtered to two microns.

Here, strictly for the birds, is the fifth in Straight and Level's Someone-Had-To-Do-It series. Actually, someone has done this kind of thing before: man's earliest attempts to do what birds do were based upon flapping feather devices. But Herr Oskar Dinort of Cologne knocks me down with a feather by producing, in the year 1958, this apparatus—said to be capable of VTOL, a speed of 137 m.p.h., and a petrol consumption of 45 m.p.g. But Herr Dinort is not unaware of man's more conventional approach to flight. So far as I know, the only other cranky thing he ever did was to design the wing of the Stuka dive-bomber.

● Somebody in Washington seems to think that the best way to employ military "aerial Jeeps" is to bring them into a theatre of operations in a big transport aircraft and fly them out of the back door. Would anyone care to join me in sliding out of an airborne Beverley on a propeller-driven rubber mattress? Or perhaps you would rather leap off the deck of a C-130 and hang from a rocket-driven rotor?

● Passengers may soon board aircraft through long, covered gangways which are extended to the entry door. This may be fine for most travellers, especially when it is raining; but I for one like to take a good, self-preserving look at what I am going to fly in.

Back in the Golden Age of the 1920s and 1930s thousands of us flew for the first time. Only the important people—business men and diplomats predominantly—flew by airline; the vast majority were initiated into the new element by Moths, Avro 504s and similar aeroplanes, operating from local fields. We saw and smelt and we felt the thrill of flying; and what a good thing we did, for in 1940 this country needed all the air-mindedness it could muster.

Today the position is reversed. In Britain "real" flying is the prerogative of the few, whereas airline travellers are numbered in millions. Somehow it isn't the same. The younger generation are growing up to regard aeroplanes as just another mode of transport, with as much thrill and glamour as British Railways. And, of course, this is how it ought to be.

● Suppose you are a stressman. The odds are you stick to wing structures, or perhaps fins, and never get a chance to lash out and try something new. I recently met an engineer who had stressed all the interplane struts on 27 aircraft. Unfortunately, he had never done anything but interplane struts, and he would have been like a fish out of water if he had been confronted with an undercarriage leg.

● Now that imperialism is so definitely offbeat, I often wonder why we persist with the anachronism Imp. gal. Surely it should now be Comm. gal? This would suit both sides.

● When I was being taught about war I was told that one of the real fundamentals was *security*. If your side had something good you kept quiet about it; and if it didn't you still kept your mouth shut. One good reason was that you had to deny the other chap any and every opportunity for checking the reliability of his intelligence sources.

Which leads me to America's second-generation ICBM, the SM-68 Titan, built by the Denver Division of The Martin Company. The first experimental round has yet to get off the ground, but any alert individual could probably write ten thousand words on Titan straight off the cuff, having read it all in American newspapers and magazines. Likewise he could write a book on the North American B-70A Valkyrie, the forthcoming Mach-3-cruise bomber of Strategic Air Command, which won't get off the ground for years. May I therefore ask the Pentagon two questions: does it believe in security, and if so, does it still cherish a hope of enforcing any? Incidentally, the two examples I have chosen have been relatively *well-kept* secrets.

● *From a de Havilland Comet advertisement, 1950:* "The passenger will feel poised motionless in space."

From a Boeing 707 advertisement, 1958: "The passenger will feel poised motionless in space."

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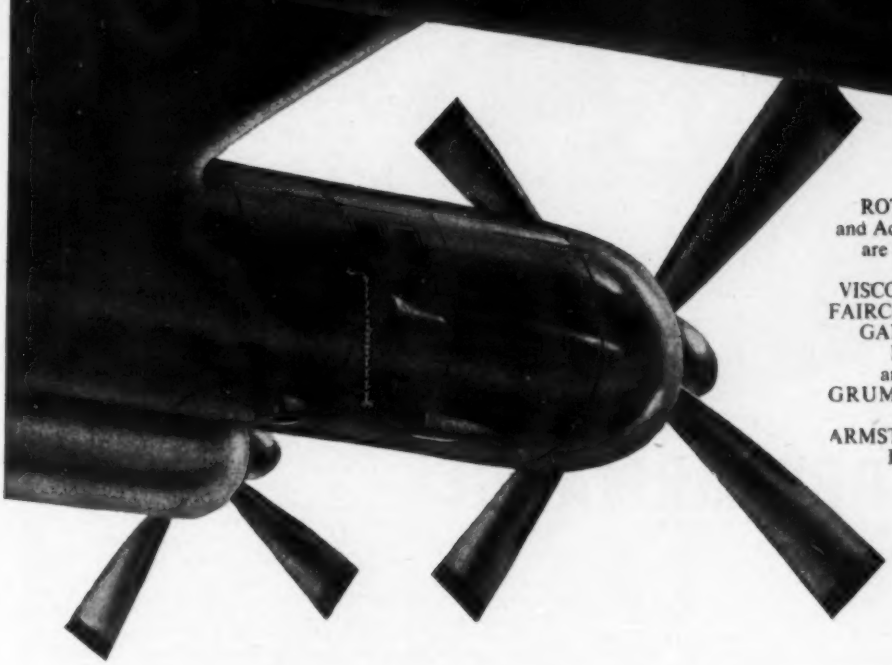

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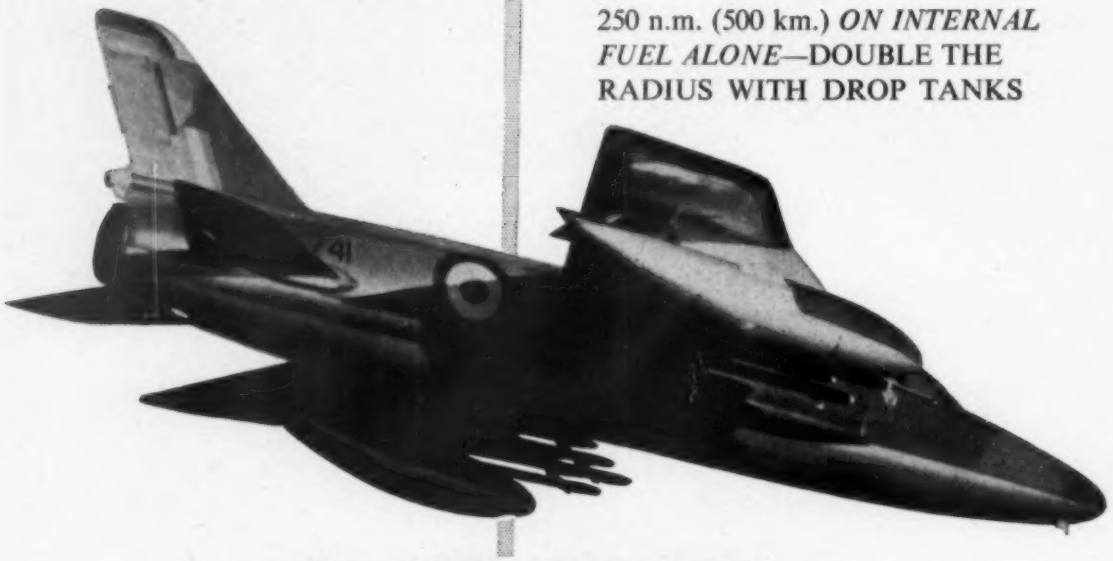

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NAGPUR JUNCTION

SPEEDING INDIA'S NIGHT AIR MAIL

by Patricia Stroud

Two DC-4s of Indian Airlines Corporation (their starboard side lettering is in Hindi), being loaded at Nagpur, centre of a busy night mail traffic.

IT used to be said that when we British left India, all the public services we had introduced there would fall into chaos—the Indians would never be able to manage by themselves. Of course, this has proved to be nonsense. India has good trunk-road communications; her railway system operates very satisfactorily with home-produced locomotives and rolling-stock, as well as some equipment bought from abroad; and the postal service, both internal and international, is swifter and more reliable than many nearer home.

In the air, India's overseas operator—Air-India International—has reached a high status among airlines; its chairman, Mr. J. R. D. Tata, is president-elect of I.A.T.A.; and the domestic operator, Indian Airlines Corporation, has become one of the biggest carriers in Asia and now includes ten Vickers Viscounts in its fleet.

I.A.C., in addition to its normal passenger and freight operations, maintains a service that (as far as I am aware) is unique outside Europe. This is the Night Air Mail Service, or NAM to initiates, an operation which is a legacy from the days before nationalization.

Recently I had the opportunity of seeing this night mail; and in spite of having to cover some 10,000 miles and to endure two all-night flights and a sojourn in India during the hottest hot season in years, it was worth all the effort if only to experience the delight of the mass take-off at Nagpur. But that comes later in the story.

To appreciate fully what the Night Air Mail Service means to India, it is necessary to remind the reader that India is more than a country; it is a sub-continent. Nagpur is about 500 miles from each of the four cities served by NAM—Bombay, Delhi, Calcutta and Madras. As each of these routes is covered twice, the distance flown every night is in excess of 5,000 miles; and the service occurs nightly throughout the year. It enables a letter posted in any one of those four cities after the closing of business offices to be delivered by the next morning's post at the other end of the route.

In addition to the mail carriage, there is a large movement of freight; and the service has also attracted heavy passenger traffic—one reason being a fare reduction for the night flight, and another, perhaps, the greater chance of a cool, smooth journey for those accustomed to the sometimes unsteady progress at low altitudes during the day. The latter reason has been largely overcome by the introduction of the Viscount, but that aircraft is now flying at full capacity on every route, so NAM still benefits.

The aircraft used for this operation have all, until recently, been DC-4s—a type regarded with deep affection by I.A.C. for its ability to carry a considerable cargo and 43 passengers as well. For some time now, owing to DC-4 modifications, a Viscount has carried the passenger load on the Delhi - Nagpur sector, a DC-3 lifting the mail and freight. This was the situation when I was there and, at the time of writing, still is.

The core of NAM operations is Nagpur, situated almost exactly at the geographical centre of India; for it is here that the DC-4s from Calcutta, Bombay and Madras, and the Viscount and DC-3 from Delhi meet in the middle of the night. Their loads—mail, freight and passengers—are discharged and exchanged, and 1 hr 30 min later the operation at Nagpur is over. An average of 11,000 lb of mail, 9,000 lb of freight and 153 passengers are tumbled out, turned in the right direction and sent swiftly on their way.

But to fly on the service, as I was able to do, and see the activity and complicated dovetailing of effort needed for the efficient operation of NAM, enlarges the picture of what appears to be simply a timetable schedule into an exciting experience.

I started out at Delhi, going first to Safdarjang Airport (for old-timers, Willingdon) to see the mail and freight being loaded into the DC-3 VT-CTZ. The Calcutta mail was already on board, and, within half an hour from the start of loading, the Madras, Nagpur and Bombay bags were in and stowed in batches according to destinations, all was lashed down and the doors shut. Precisely at its scheduled time of 2300 hr the DC-3 took-off for Nagpur. Already at this hour three other night mail flights were heading for Nagpur, from Bombay, Calcutta and Madras, with only the Delhi Viscount waiting to go. The efficiency of the loading operation would have warranted admiration by any standard. It must be remarked, however, that India has peculiar labour problems to overcome in that workmen such as loaders are as yet illiterate; so identification of load destinations is carried out by means of coloured labels.

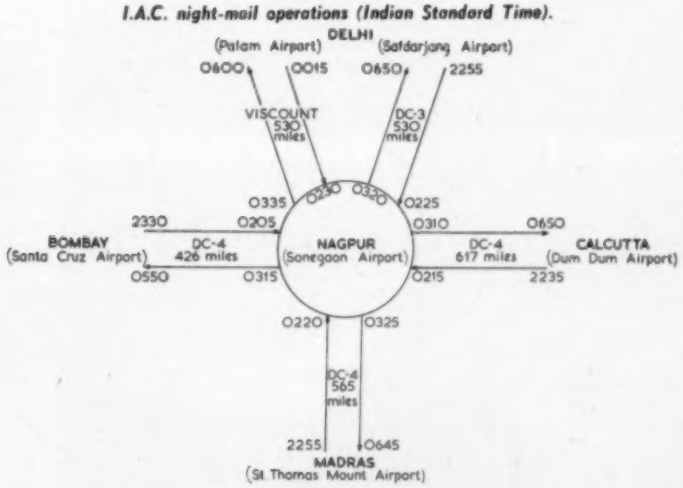
The Viscount departure was from Palam Airport, whence VT-DIG, with myself and 31 other passengers on board, took off at 0015 hr. This was unquestionably a night flight, for the immediate actions of the passengers (all obviously old customers of I.A.C.) on entering the aircraft were to provide themselves with pillows and blankets; then off came their shoes and they were bedded down for the night. The steward went round with cool drinks, the cabin lights were dimmed and everyone dropped off to sleep.

We flew in bright moonlight at 15,500ft, calm and cool, the perfect night for visiting the Taj Mahal; but our only contact with that fabulous site was a crackling voice in the darkness from Agra radio wishing us goodnight as we left its area. Then on and on over winking villages, until we landed at Nagpur to take our place in the line-up of aircraft on the apron, all the others having arrived within the previous 25 minutes.

(*Concluded at foot of page 474*)

Passengers as well as mail are carried on the Night Air Mail.

I.A.C. night-mail operations (Indian Standard Time).



POPULAR FLYING IN THE U.S.A.

Official Encouragement for the "Homebuilt"

By BOB WHITTIER

WRITTEN by a member of the Experimental Aircraft Association with an intimate knowledge of the U.S. amateur-construction movement, this article surveys the current popular-flying scene in that country. Although the scales of activity here and in the U.S.A. are vastly different, many of the amateur constructor's problems and ideals are clearly universal.

THERE'S something new in America's private-flying scene. Interest in amateur-built airplanes has been growing with amazing rapidity in the last few years and, all over the country, men are building small aircraft in garages, back-yards and hangar corners. Their products have been showing up at airports and in the Press with increasing frequency, and it is obvious to everyone that something's afoot.

Actually, homebuilt airplanes are nothing new. Many of the pioneer types built before World War I were assembled by experimenters working in bicycle shops, barns, church basements and other structures in no way resembling aircraft factories. For a decade after that war, anyone who wanted something other than a surplus "crate" had to build his own or have it built to order. The Lindbergh era, which was followed by the 1929 depression, found many an American youngster imbued with a burning desire to fly but without the wherewithal, so again there was the incentive to build in the basement. In the middle and late 1930s the appearance of good, cheap factory-built lightplanes, plus official disapproval put the homebuilding movement out of business for all practical purposes, although there were plenty of diehards among the would-be builders.

Thus when the clouds of World War II lifted there were quite a few men scattered around the country who not only saw nothing remarkable about building one's own airplane but had developed quite an urge to take up where they had left off several years before. At their urging, the Civil Aeronautics Administration between 1947 and 1952 gradually relaxed certain provisions of the Civil Air Regulations which had kept the homebuilts on the ground. At first a few old-timers were the only ones to be active, but it didn't take others long to see that they were missing a lot of fun. Interest has grown to the point where today the amateurs have their own national organization with over 3,000 members, 40 chapters, and regular regional and national meetings.

There are many reasons why men choose to forsake conventional spare-time activities and devote from one to five years of tedious labor to building an airplane. There's the creative urge, the ambition to be different, the desire to develop a pet idea, the advanced model-airplane builder who wants to step up, the old-timer who wants to realize a dream which was thwarted by wars, depressions and responsibilities, and the simple desire to own a highly personalized airplane. By and large, your average homebuilder turns out to be a dyed-in-the-wool aviation enthusiast whose interest is in the airplane itself, not in what it can carry or how much money it can save.

Another reason is becoming more apparent. Today there are many thousands of men who learned to fly in military or government pilot-training programs ten to fifteen years ago. They've settled down in 1958 to good jobs as technicians, contractors, professional men, merchants, white-collar workers, service workers and all the other middle- and upper-class occupations found in every town and city. Their daily work does not call for extensive travel. They have no use for an executive-type airplane—nor the money to buy one. Yet they do remember the fun of flying and, now that they are beginning to have a bit of time and money to spend, look longingly towards the airport.

A flock of light two-seaters appeared on the market in the late 1930s at a time when hangar space was readily available at a reasonable price. Then World War II came along and thousands of these ships were built as trainers. In the hands of post-war private pilots all these airplanes have proved to be rather expensive toys, for hangar space is now in short supply and costs a lot of money. Even a 65 h.p. lightplane takes up an appreciable amount of room! Regardless of its construction an airplane stored in the open is at the mercy of sun, wind, rain, ice, vandals, lightning, grass fires and many other hazards. A man does not own such an airplane . . . it owns him!

Although basically cheap enough to operate as regards fuel and routine maintenance, an average lightplane can bankrupt its owner while sitting in a hangar or tied down outdoors. On top of that, such used aircraft as are still available are bringing higher and higher prices, and the cheapest production two-seaters today sell for something over $5,000.

It is obvious that those thousands of men who fly for fun, or would like to do so, are running out of airplanes in which to do it. In view of today's engineering and manufacturing costs they see little hope of new production sportplanes coming along at prices they can afford.

Actually, we have never had a lightplane really suited to the needs of "casual flying" in this age of inflation. The fact that many of these amateurs are tinkering with midget planes, roadable planes, folding-wing planes and rotary-winged aircraft highlights the point that they want something that can be stored away cheaply and safely for those days, weeks and even months when weather, business, or family responsibilities, preclude flying. Instead of sitting down and moaning, they are rolling their sleeves up and building what they need.

Make no mistake about it, there is a tremendous amount of latent interest in pleasure flying. The homebuilding activity we have seen thus far is but the surface bubbling of something which goes very deep. A few years ago one mechanical magazine published an article on the homebuilding movement and the story pulled the utterly fantastic number of over 3,000 reader letters!

The C.A.A. has taken cognizance of the interest-building aspect of amateur aircraft-construction activities. Charged by Congress with the responsibility of fostering interest in aviation, the C.A.A. is acutely aware of the shortage of trained pilots, mechanics, engineers and other technicians and has initiated an Aviation Incentive Movement for the purpose of encouraging young men to choose careers in aviation.

The amateur construction of a simple airplane is the next logical step for a youth who has mastered the art of model-airplane building, and the prospect of someday being able to fly a ship he has himself built or helped to build can be so stimulating to him that homebuilt airplanes fit perfectly into the A.I.M.'s work.

Private aviation today has all its eggs in one basket—business flying. As a direct result of this, American youths hear little and know less about aviation. They cannot identify themselves with the corporation-owned airplanes they see parked at airports. Aviation magazines are slanted so much toward the business pilot and those who are already interested in aviation that they have lost the basic interest they used to hold for the boy-in-the-street. A typical aviation magazine twenty years ago was full of general-interest articles, personality sketches, adventure yarns and model

Miller Twin with two 65-h.p. Lycoming engines—an example of modification of a production aircraft (in this case a Piper J-5 Cruiser) with serious motives. The C.A.A. faces the problem of framing regulations which will not handicap worthy amateur projects of this kind

Baby Ace, flown by Arnold Quarton of California to last year's Fly-In staged by the Experimental Aircraft Association at Milwaukee, Wis.

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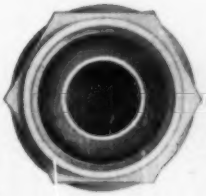

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(Left) Formerly the Rose Parakeet, in limited production in the late 1930s, this craft is known as the Hannaford Bee; although of only 20ft span it is said to have docile flying qualities. (Right) George Meyer's "Little Toot," which won the 1957 E.A.A. Fly-In trophy for outstanding design. It took five years and $2,000 to build; plans are now available at $50 per set.

POPULAR FLYING IN THE U.S.A. . . .

airplane plans. It did a fine job of catching the attention of the young man standing in front of a magazine counter. Today's aviation magazine is filled with articles about atomic bombers, omnidirectional radios, cold fronts and stories of corporations which own airplanes . . . and it scares the public into buying automobile magazines instead! This is not to criticize the magazines, for they have to follow business trends, but it does point up that aviation as a whole has drawn away from the average boy and man.

At this stage, however, the chap who builds his own airplane is not at all an average young man. The nature of the project is such that he must essentially be a cut above others in ability and ambition. So much the better for aviation! It has been the history of all progress that significant trends, inventions and products have gotten their start at the hands of dedicated tinkerers working in basements and back yards.

A man cannot rip up some packing crates, borrow some baling wire, take his wife's bedsheets and fashion an airplane which the C.A.A. will approve. Regulations governing the licensing and operation of amateur-built aircraft are strict, yet fair. Structural details and the quality of materials used must conform with approved practices as outlined in Civil Aeronautics Manual 18. Builders are urged to inform their local C.A.A. office when they start construction so that a "safety agent" can follow the progress of the work. A certificated aircraft mechanic must approve the materials and workmanship, after which a safety agent inspects the structure before it is covered. At the time of original certification, suitable operation limitations are established as the individual case appears to warrant.

Amateur-built airplanes cannot carry passengers for hire. They cannot fly more than 25 miles from their home fields until they have completed 50 hours of satisfactory flight, during which detailed records must be kept of all noteworthy or unusual occurrences. They can carry non-paying passengers only after this 50-hour period and then at the discretion of the safety agent. They cannot be used in any commercial pursuit. A person must have a Private Pilot Rating, or better, to fly a homebuilt airplane. The use of shoulder harnesses is encouraged, and parachutes are worn during test flights. The old fear that a farm boy might build a "crate" and attempt to teach himself to fly out of a pasture no longer exists.

Quite aside from all these facts is the truth that most amateurs love to talk about their projects, and as they now have a national organization most homebuilts are seen in all stages of design and construction by friends who know airplanes thoroughly. If somebody undertakes a crackpot or ham-fisted project, the C.A.A. generally hears about it long before it is presented for approval.

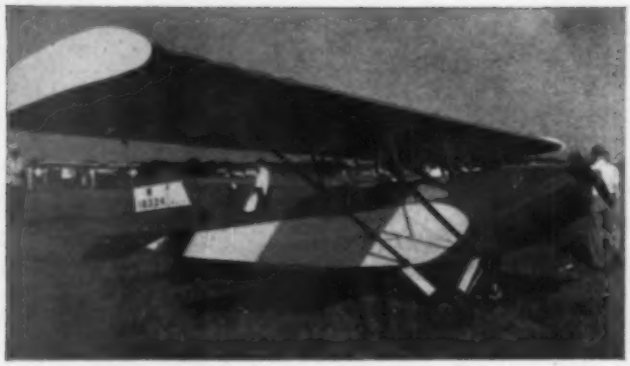
The C.A.A. has expressed itself as being satisfied with the homebuilt's safety record, which has been good. Such accidents as have happened have been attributed largely to pilot carelessness—a cause which is found in every branch of the flying game. There have been very few accidents due to structural or mechanical failure.

One C.A.A. official who has had extensive dealings with amateurs says: "We have found that the average homebuilder is exceedingly proud of his product and, due to the time and money he has invested, will not intentionally jeopardize his airplane . . . the average owner has been found to be a mature, stable individual equal to the responsibilities of his undertaking . . . the standard of maintenance in amateur-built aircraft is high."

This Ford "A"-powered Pietenpol, built in 1934, is still in perfect flying condition, even to having the original unbleached muslin covering on its fuselage in perfectly airworthy condition.

The C.A.A. intends to give homebuilders its continued moral support, and its biggest concerns deal not with safety but with what might be called "growing pains." Some men have been modifying production-type airplanes extensively to produce craft which differ markedly in configuration and performance from the stock design. On the one hand, C.A.A. must keep its regulations regarding aircraft modification liberal enough to allow crop dusters, aerial photographers and others to make changes which are legitimately needed to adapt aircraft to special purposes. On the other hand, these same regulations must be tight enough to

(Left) The Pietenpol owned by Donald Nordsving, Canton, Minn., has a 60-h.p. Franklin engine and modified landing gear; simple, sturdy all-wood construction design has stood up well in service. (Right) Another Baby Ace, built by Everett Hepler of Rochester, N.Y. and fitted with a full cowling. Plans printed in a technical magazine in 1955 did much to accelerate progress of the homebuilding movement.



(Left) The Pietenpol owned by Everett Schermerhorn has fully-cowled 65-h.p. engine, improved landing gear, and tip plates. The tip-plate fad now appears to be dying out following publication of engineering articles in the official E.A.A. organ stating they are not particularly effective. (Right) Students of St. Rita's High School, Chicago, built this Baby Ace under supervision of instructor Robert Blacker.

POPULAR FLYING IN THE U.S.A. . . .

prevent whimsical, unnecessary changes at the hands of tinkerers.

This is both for the sake of safety and to protect the good reputation of manufacturers who have gone to very considerable effort in obtaining Approved Type Certificates for their designs. Both the C.A.A. and the amateurs' national organization, the Experimental Aircraft Association, have taken firm stands on the matter and the airplane-butcher is finding his path into the air an increasingly rough one.

A second matter concerns the commercial aspect of homebuilts. The "amateur built" category set up by C.A.A. specifically states that aircraft so constructed and licensed must have been built for "pleasure and education" purposes. The man who develops an amateur design which works out well soon finds people asking him for sets of blueprints, which he is glad to sell as a means of justifying the time and skill spent in developing the aircraft. Presently people in out-of-the-way places write to him and ask where to get hard-to-find steel tubing, plywood, spruce and other basic construction materials not often stocked by local maintenance shops. So he starts selling such items. It is not long before he offers to cut the raw tubing to length and tack-weld it together in his original jigs, thus saving other amateurs that much time and expense. Inevitably, someone who does not trust his own welding ability or owns no torch asks for a fuselage all welded up, as a matter of safe procedure. That is all well and good.

However, the chances are good that somebody with little spare time but plenty of money will take a fancy to a good design and ask to have a complete airplane built to order. This can quickly lead to trouble for everybody, because it is getting away from the "pleasure and education" field of homebuilding and encroaches on the province set aside for those who have invested heavily in Approved Type Certificates and accompanying manufacturing facilities. There is also the problem of the owner of an amateur-built aircraft having peculiar flight or mechanical characteristics becoming tired of it and selling it to an unsuspecting or inexperienced newcomer. At this stage, C.A.A. is debating where and how to draw the line.

Lest the impression may have been given that U.S. homebuilts pose a serious regulatory problem, it should be noted that fewer than 300 are known to be flying today, and perhaps 400 have been definitely reported as under construction. Overall, the situation is well in hand and there is time and opportunity to develop policies and regulations at a deliberate pace. It should be easier to maintain a satisfactory safety record among several hundred new, pampered homebuilts than may be the case among several thousand lightplanes which have been sitting out in the weather for twelve, fifteen, or eighteen years.

Usually the real newcomer builds his plane from plans of a design which has been built in sufficient numbers for its safety and handling qualities to be a known factor. The activity is in a "learning and developing" stage at present. The trend is away from clipped-wing, midget and modified types towards larger, gentler utility types. Some of the designs are very carefully engineered according to formal procedures. Others are the products of "eyeball engineering," which fact gives rise to apprehension in some quarters. Yet the truth remains that the actual function of an aeronautical engineer's stress analysis and performance calculations is to make an airplane as light, fast and cheap as possible to satisfy the sales manager, accounting department and rigid customer requirements. The eyeballer looks at ten different airplanes at the airport, notes that one-eighth-inch control cable is used, the longerons all seem to be of three-quarter-inch tubing, and elevators have an average of 30 deg travel. He averages things out, weighs them in the light of a general understanding of beam strength, bracing angles and column strengths, and comes up with a sturdy airplane. A skilled engineer might make it lighter and more efficient, but the amateur does not worry too much about such things. Actually, this way of designing may be a lot safer than having an amateur try to apply unfamiliar engineering theory with no practical checks and coming up with a design having a weakness which mathematics did not reveal.

The average age of homebuilders, according to a recent survey, is 38 years. Most of those who actually finish airplanes are highly skilled pilots, mechanics and technicians. The newcomers are on the whole intelligent and methodical, and are under the eagle eye of old-timers. The C.A.A. thinks the safety record looks all right. It does not seem as though the activities of homebuilders pose much of a threat to aviation's safety record.

On the other hand, there are many tangible benefits. High-caliber youths can be attracted to aviation. Engineers suffering from the "I'm just a small cog in a huge machine" feeling in today's enormous aviation plants can get their personal sense of achievement out of small sportplane designs. Both engineers and mechanics who undertake to design and build small planes gain benefits ranging from practice in "thinking things through" to a better appreciation of the airplane as a whole, as opposed to the specialist aspects most of them deal with in their everyday work. A small but steady demand is created for special materials, small engines, propellers, tires, finishes and parts of many descriptions . . . which may help commercial aviation cater to unforeseen future needs. Newcomers who want to join the fun are obviously customers for flying schools. The enthusiasm of amateurs can help in saving small local airports from the real estate speculators. The more small airports there are, of course, the better it is for those who fly for business. The activities of amateurs make excellent stories for newspapers and broadcasting stations on the local level, thus giving badly needed substance to national efforts to promote interest in aviation.

In time, this thing could amount to something big. The men who want to fly for fun feel that aviation has neglected them —and they are doing something about it.

Typifying new-generation homebuilts is the amazing Wittman Tailwind, which cruises at 150 m.p.h. on 85 h.p., seats two, and has a flat windshield to carry through the aerofoil shape of the fuselage contour; this is said to add to lift. Wittman is a famous old-time race pilot.

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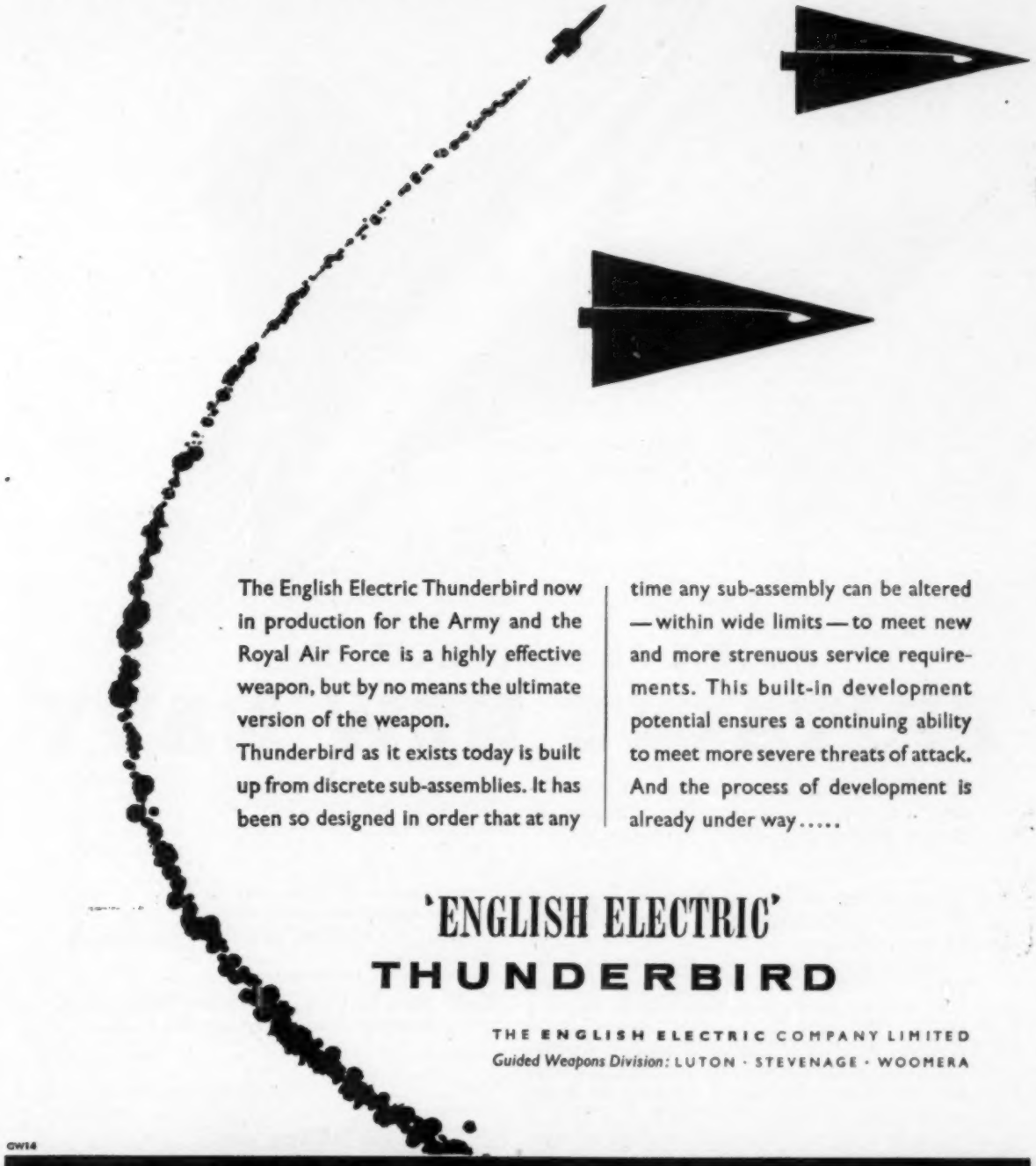

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CORRESPONDENCE

The Editor of "Flight" is not necessarily in agreement with the views expressed by correspondents in these columns. The names and addresses of the writers, not for publication in detail, must in all cases accompany letters.

Wanted—New Light Aircraft

UNDER the heading "Missing from Farnborough," in the leader in *Flight* for August 22, an extremely important point was raised. It has been for some time a matter of grave concern to the Royal Aero Club that the light-aviation industry of this country is dying very rapidly. While recognizing that Austers (as the only representative of post-war light aircraft construction) have been doing their best, it is fair to say that the designs now available from Rearsby would find difficulty in competing with current American models were it not for the artificial financial barrier imposed by the authorities in this country. The Royal Aero Club and the Popular Flying Association, which is associated with it, have been taking what steps are possible to introduce new types into Great Britain. As a result of the initiative of private individuals, there are now available, or there will be shortly, a number of ultra-light aircraft of modern design and reasonable price. The Luton Major, Druine Turbi, Turbulent and Condor and Piel Emeraude are all within this category, and when production of the Garland-Bianchi Linnet commences the prospect will be somewhat brighter for British light aviation.

In all these pies, the Royal Aero Club has had at least one finger, and in many cases has done a great deal of energetic stirring as well.

We agree wholeheartedly with the conclusion drawn by *Flight*, and we hope most earnestly that a suitable light aeroplane may soon be placed in production by a British firm on a large scale. The European and Commonwealth market undoubtedly exists and there is a large potential market also in South America. A modern light aircraft built in the sterling area would be a boon that most countries would be quick to appreciate. So far only the French appear to have had the individual enthusiasms and official financial wisdom to create a powerful force of light aircraft and pilots. The presence of 85 ultra-light aircraft from all parts of France at the R.S.A. Rally on August 15-16 is sufficient indication of what can be done in a country which is ostensibly far worse off financially than ours.

London, W.1. J. H. BLAKE,
Editor, *Royal Aero Club Gazette*.

Corporation Manpower

I SUSPECT very strongly that Mr. D. F. Ogilvy (Correspondence, August 29) has an argument which, properly pursued, would show up the "jumbled maze of nationalized inefficiency" that B.O.A.C. now is. This simple approach of the ratio of total staff to total aircraft strength, however, leaves him wide open to all manner of red herrings. Not only figures but also so-called commonsense may be made to prove anything if one is as desperate as B.O.A.C.

What would be revealing is a further analytical comparison of staff strength under a number of major categories, such as pure maintenance, repair and overhaul, overseas stations, managerial, and clerical. Has I.A.T.A. or the Air Research Bureau made any such analysis of major operators?

Maintenance staff are always the primary target for any redundancy programme, but I suggest that an analysis of this type would reveal clerical and managerial staff to be an equally worth-while target. My own personal experience is that, where a nationalized concern has a department, an independent operator often "makes do" with one man and a typist and yet achieves commercial success. Paper-work without an ingrained commercial outlook has a tendency to snowball: in most independents, however, the pace is too hot for snowballs.

And let's not belittle the operational difficulties of the independent; the number of aircraft, the number of different types, their age, and service frequencies often bring problems comparable with, or even exceeding, those of the Corporations with their more far-flung routes.

As Mr. Ogilvy says, the independents could certainly advise B.O.A.C. on administrative efficiency. Moreover, I suggest that B.O.A.C. would do well to try to recapture the sense of purpose, competition and commercial economy that is so evident among the independents, and which is so essential.

Windsor, Berks. C. JOHN BARRON.

Loss to Technological Education

IT is with much misgiving that I read of the ultimate dissolution of the School of Gas Turbine Technology, Farnborough. It seems to me that, even from the point of view of British prestige abroad, this is a step that should not have been taken without long and due consideration, and perhaps the reasons and economics of the situation might have been given some wider publicity.

I cannot pretend to know how the Board presented their case to the Treasury, but there must be some thousands of technicians both in the three Services and in industry who, although doing a good job of work, could do it twice as well had they the advantage of a course at this school. It might even be worthwhile raising the status of the courses to diploma level; but since so many overseas and foreign students have attended these courses, and since we have held the field with this unique school for some 14 years, it seems altogether unhappy that it should pass out of existence with one of the tersest obituary notices ever written.

As mentioned before, many in the outside world know so little of the facts that it is not even possible to assess the economics of keeping the school open, but in the annual financial estimates it surely must be a very small figure compared with other expenditures. I certainly hope that the question of closing will be re-discussed, thrashed out and better publicized before the last courses have been completed.

Shepperton, Middx. V. N. BUTLER, A.M.I.P.E., A.R.Ae.S.

Pioneer Efforts

IT is believed that Lord Gorell has given careful consideration to the correspondence in your columns and to several theories, calculations and representations re the 1908 pioneer efforts of A. V. Roe; and that, on the ground that no new evidence has been forthcoming, the Royal Aero Club intends to let the present record stand.

After re-reading the several accounts and pleas it occurs to me that possibly the basic point has been missed, since the contributors to the case have all been too close to the wood to see the trees. Surely, the remark of the Marquise du Deffand should apply to A. V. Roe; on being informed that St. Denis, carrying his head in his hands, had walked two leagues, she remarked: "La distance n'y fair rien; il n'y a que le premier pas qui coute!"

In modern parallel, the first successes of Edison and Marconi were trivial to the almost immediate developments that followed, but nobody has denied them their pioneer honour because their initial efforts were so limited in results. So with Roe, who appears to suffer from the limitations of the definition imposed by the Gorell Committee—and that definition misses the significance of the remark, the true remark, of madame la marquise in 1763.

London, W.1. BERNARD HURREN.

Rotodyne Ante-dated ?

THE writer considers it would be of interest to place on record a few notes concerning an early British helicopter before the subject becomes obscured in the mists of time.

A search of old Victorian patent specifications will disclose the fact that the preponderance of many weird and utterly unworkable contrivances were based on some form of helicopter. Machines embodying the purely aeroplane principle are conspicuouly few. Among the former are specifications of a Scottish engineer—one George L. O. Davidson. In and around 1906-09 this inventor was probably the most forceful character in this field in Britain. He wrote extensively on the subject in engineering journals and was for ever banging the drum to call attention to the fact that he "possessed the secret of Nature, that enabled the birds to fly."

His closely guarded "secret" ultimately turned out to be that of the large-area rotor having articulated blades at a fine pitch, which idea was re-invented by Cierva of Autogiro fame some 20 years later. Having discovered this, Davidson had his foot firmly on the right road, but no one in those days could appreciate it; like most prophets, he was largely scoffed at. Yet here again he was not the original inventor. That honour must go to Sir Hiram S. Maxim for his British patent No. 10620 of 1897. Incidentally, the late Sir Alliott Verdon-Roe (as young Mr. A. V. Roe, of course) worked for Davidson as draughtsman on his helicopter, thus becoming the first British helicopter draughtsman, but not the first in the world, since there were French helicopters in existence before Davidson's.

Unlike most inventors, Davidson was a competent engineer and a man of energy, foresight and determination. At that period of time he had business interests in Colorado, U.S.A., consequently he had to construct his machine there, or not at all. Roe worked with him in Colorado but soon returned to England, to be followed, some time later, by Davidson. Constructional work on the helicopter was commenced in 1906 at Denver, Colorado. The machine comprised two large rotors 30ft each in diameter, one each side of a stubby fuselage and driven, through gearing, by two sets of steam engines and boilers taken from two Stanley steam cars, popular at that time in the States. There is reason to believe that this affair did actually lift its own weight (as Davidson

CORRESPONDENCE . . .

claimed); but steam pressure had to be raised to a dangerous point, with the result that one of the boilers burst, wrecking the machine.

After his permanent return to England, Davidson (who had wealthy friends) commenced the construction of a far more ambitious project, much on the same general lines, but this time with a long fuselage similar to that of the present-day passenger airliner, on two floors, complete with small buffet, lavatories, etc., all highly skilful light aluminium work, although the main structure was in wood. Considering the period (1909-10) this general design was some 40 years ahead of its time. Davidson invited various people connected with aviation to view his work (which was carried on in the grounds of a large house at Taplow, Buckinghamshire), the writer being one among them.

The similarity of the whole layout to a modern airliner was very striking, even to the pilot's cockpit. Among other points of interest the writer was shown the "engine room" on the lower floor—a compartment big enough for a large marine diesel engine. When questioned on the powerplant he proposed to use, Davidson was purposely vague. The writer's idea at the time was that there was no aero engine in existence a pair of which could have flown the machine. Even today, it would take two powerful aero gas-turbines to lift its great bulk. Two such engines would either have flown it or have torn it to pieces in the effort.

Subsequently Davidson became short of money (his backers probably having withdrawn from the venture) and advertised extensively for capital. Apparently insufficient was forthcoming, for the machine was never completed and was ultimately broken up. However, in common with Maxim's steam aeroplane at Baldwyns Park in 1893, the whole affair was a most determined effort on the part of a Victorian steam engineer to build a successful flying machine.

In addition to his lifting rotors, Davidson's design incorporated fixed wings each side of the fuselage, amply large enough in area to fly the machine without any lift from the rotors. In common with the Fairey Rotodyne it was primarily intended to be lifted into the air by the helicopter rotors, and to be sustained in forward flight by its large aeroplane wings, forward propulsion being obtained from the said rotors. In this latter respect it was one jump ahead of the Rotodyne, even in 1910. In keeping with the general design, it had no wheeled undercarriage, but a tandem pair of landing buffers beneath the imposing double-decked fuselage are shown in the illustration. In 1910 the machine was considered by the public to be merely a Wellsian or Jules Verne dream —which, to a large extent, it was.

London, S.W.17. E. V. HAMMOND.

The R.34 Memorial

THE controversy over the proposed R.34 memorial suggests that we may achieve more by analysing what the Air League really wants, then seeing if the proposed solution fulfils it. The sculptor was asked, presumably, to provide a monument to the endeavours of an airship crew. He was also probably told that it would be a focal point in the terminal building. The problem then became that of the designer, because the specification was vague. Either that or his own analysis was insufficiently precise. I would digress here to point out that ALL solutions must be abstract in some degree—even a model has a "scale effect" upon the eye. An airship, or those that I remember, was a light thing which became monumental when it came close. It moved very sedately, purposefully and with all the tranquillity of a horde of Harvards. Such a memorial must incorporate an intangible spirit, human endeavour—that of the men who built, designed and flew it with all the skill they knew.

The synthesis of this problem provides several possible answers. One solution is sculpture, which relies upon the play of light upon its form for its effect. (A wire or tubular sculpture *encloses* space, and cannot therefore be suitable unless placed upon a sky- or space-line, e.g., any pylon-line or TV mast.) The problem now is how to get the requisite feeling into the solution. Purpose, endeavour, sedate, men, spirit . . . all of them abstract words needing definition in a tangible manner, not to mention "distance" and "skill." I am personally forced to the conclusion that the approach is not unreasonable but that the medium is wrong. One cannot capture grace with texture, distance by proportion, skill on stilts or purpose by multiplying heads; and yet all these are needed and can be provided for if it is accepted that the present medium—probably bronze—is wrong.

My proposal is that the sculptor and the Air League seriously consider a translucent medium. Perspex, for example, this, however, needs to be polished and scratches show. Fibreglass *might* do, but this is beyond my knowledge (a sculptor/designer in the medium, such as Aidron Duckworth, would know). Glass would definitely do so. All other art forms attempt to represent light or the effect of it. Glass is the only one to use it for its own sake.

I do not know the precise site of the monument, but it must have windows in it or overlooking it; it is therefore lit. These windows can be used for a monumental device employing sand-blasting as a technique. The work of existing artists in the field, such as Goodall in the south of England and Mochrie in the north, proves it possible.

My own preference is to keep to the specification and employ a worked prismatic piece on a base of some polished exotic wood (wenge, walnut or oiled teak). A small inscription could be engraved in such a way that the letters seen in the block of glass formed a natural abstraction behind the side nearest the viewer. If this seems revolutionary to the realists, then a large piece of engraved hollow-ware could be lit from below on the base. In this way one uses shape and finish to provide the grace of the original, distance by an apparent depth, skill by precision in the sandblasting or engraving and the light factor, contrasted with the rich wood, to unify the whole. It would be equally effective under all light conditions and would probably be at its best at dawn and dusk. The conception is original enough to emphasize both our present workmanship and skill as well as the spirit of achievement which it would mark.

I agree with the spirit in the comments of Roger Bacon and Jack Bruce, but not in their methods. I can appreciate the problem of the sculptor and suspect that the Air League and himself must be vaguely dissatisfied with the answer in producing an attempt to explain it.

Surbiton, Surrey. JOHN GAYLARD.

Simple Simulator

I WONDER if any of your readers could give me any information regarding a device which I remember seeing some forty years ago. It was located in a small factory yard in Hythe Road, Willesden, next door to the premises of Messrs. Arnott and Harrison. I think the title of the company was British Aerial Transport, Ltd., and if my memory serves me rightly the leading light was Mr. Fred Koolhooven. The device consisted of a small nacelle mounted on a tripod and fitted with a control column and lateral and longitudinal levels. Operation of the control column caused the nacelle to assume the attitude that an aircraft would, comparable with the stick movement.

Being associated with a young flying club, it has struck me that such a device could be very useful in training prospective pilots and familiarizing them with the normal functions of controls and maintenance of an even keel. I would like if possible any opinions on the feasibility of such a gadget as a primary ground trainer, as I am quite sure that construction would be well within the capabilities of our members and would probably do much to maintain interest while the majority of some sixty people were waiting their turn for instruction.

Coventry, Warwicks. S. E. PHILLIPS.

FORTHCOMING EVENTS

Sept. 15-21. Battle of Britain Week.
Sept. 21. B.G.A.: National Sailplane Aerobatic Contest, Dunstable.
Sept. 21. Royal Belgian Aero Club: 900 cu m Balloon Competition.
Sept. 21. Milan Aero Club: Rally.
Sept. 21. Denham Flying Club: Garden Party.
Sept. 22-27. A.C.I.M.A. Third European Aeronautical Conference, Brussels.
Sept. 25. R.Ae.S. Graduates' and Students' Section: "The Next Generation of Civil Aircraft," by G. H. Lee.
Sept. 25-26. Aerodrome Owners' Association: Annual Conference.
Sept. 26-29. Austrian Aero Club: Innsbruck Rally.
Oct. 9. Society of Instrument Technology: "Aircraft Flight Simulators," by Dr. A. E. Cutler.
Oct. 10-11. College of Aeronautics, Cranfield: Open Days.
Oct. 16. R.Ae.S. Graduates' and Students' Section: "The Fatigue of Aircraft," by Major P. L. Teed.
Oct. 16-17. British Interplanetary Society: Space Medicine Symposium and Twenty-fifth Anniversary Dinner.
Oct. 20-29. AGARD meetings, Copenhagen.
Oct. 23. British Institution of Radio Engineers (Scottish Section): "Flight Evaluation of Airborne Electronic Equipment," by H. G. Hinkley (at Glasgow).
Oct. 24. British Institution of Radio Engineers (Scottish Section): "Flight Evaluation of Airborne Electronic Equipment," by H. G. Hinkley (at Edinburgh).
Oct. 29. R.Ae.S. Graduates' and Students' Section: Annual Film Show.

R.Ae.S. Branch Fixtures:—Sept. 17, *Coventry*, "Design of Pattern equipment for an Aero Engine Casting," by K. Marston; *Weybridge*, "The Tyne Engine," by D. McLean. Sept. 22, *Henlow*, a.g.m. and film show. Sept. 23, *Luton*, film evening. Sept. 24, *Manchester*, "Why Airlines are Hard to Please," by B. S. Shenstone. Sept. 30, *London Airport*, "The Boeing 707," by M. Pennell. Oct. 6, *Henlow*, "Mixed Powerplants," by M. J. Brennan. Oct. 8, *Manchester*, "Problems of Supersonic Flight," by L. P. Twiss; *Weybridge*, "Physiological Aspects of High-performance Flight," by Dr. K. G. Williams. Oct. 21, *Luton*, "Fatigue Testing of the Fokker Friendship," by E. J. van Beek. Oct. 29, *London Airport*, brains trust; *Weybridge*, brains trust. Nov. 4, *Luton*, "Guided Flight," by L. H. Bedford. Nov. 12, *Manchester*, "Digital Differential Analysers," by K. V. Diprose; Nov. 18, *Luton*, Discussion Evening. Nov. 19, *Weybridge*, "Training of a Production Engineer for the Aircraft Industry," by Professor J. Laxham. Nov. 21, *Luton*, Annual Dinner. Dec. 2, *Luton*, "Satellites," by E. M. Dowten. Dec. 4, *London Airport*, "Airline Operational Flying," by Capt. W. Baillie. Dec. 10, *Manchester*, "Civil Aircraft Production," by P. Imlach; *Weybridge*, R. K. Pierson Memorial Lecture, by B. S. Shenstone. Dec. 19, *Weybridge*, Annual Dance.

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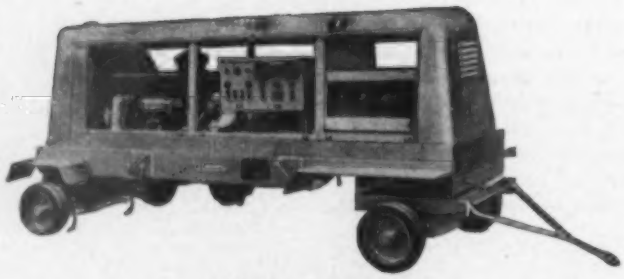

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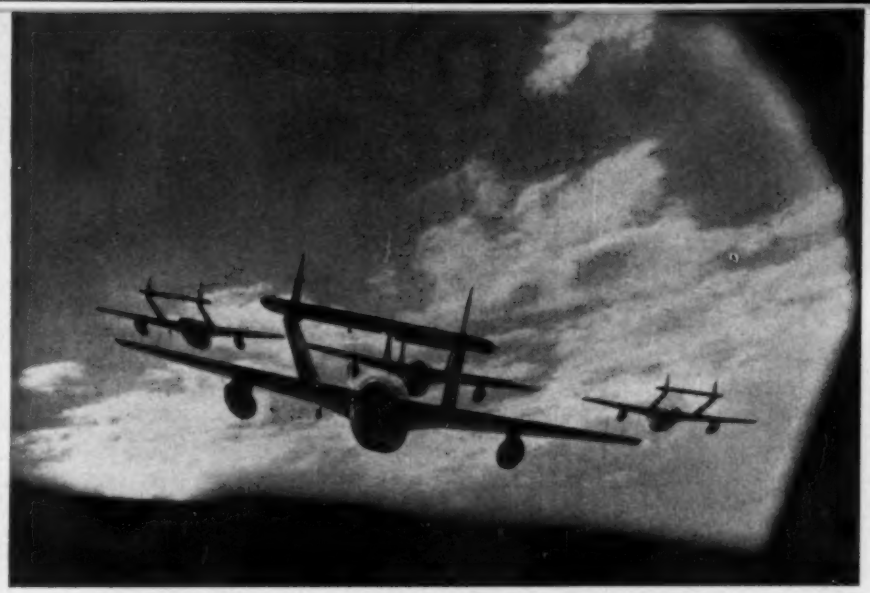


An unusual view of a Vampire formation taken recently by Russell Adams when he was at R.A.F. Thorney Island with the A.T.C. unit of which he is C.O. The Vampires, from No. 2 A.N.S. and led by S/L. W. S. O. Randle, were forming the "T" of the station's initials in practice for its Battle of Britain "at home."

Senior Appointments

APPOINTED Controller of Engineering and Equipment from February 1 next year, with the acting rank of air marshal, A.V-M. H. D. Spreckley is to be succeeded as A.O.C. No. 24 (Training) Group, Technical Training Command, by A.V-M. J. Marson, with effect from January 1, 1959.

A.V-M. Spreckley, who entered the R.A.F. as an apprentice, was Director-General of Technical Services at Air Ministry before becoming A.O.C. No. 24 Group; and he had previously been Commandant of the R.A.F. Technical College at Henlow. His successor-designate at No. 24 Group, A.V-M. Marson, is at present Director-General of Technical Services at Air Ministry and was President of the Ordnance Board from March 1956 to March 1957.

R.A.F. Postings

AMONG R.A.F. appointments recently announced by Air Ministry are the following:—

G/C.s A. D. Balmain to Central Servicing and Development Establishment, to command; H. R. Free to Ministry of Supply; L. H. Snelling to R.A.F. Record Office, for administrative staff duties; A. F. Ward to Central Signals Area, to command.

W/C.s W. J. Swift to Teheran as Air Attaché (with acting rank of Group Captain); R. J. Walker to R.A.F. Hereford, to command (with acting rank of group captain); C. S. Betts to R.A.F. Technical College, Henlow, as Chief Instructor; F. A. Buckingham to No. 25 M.U., for administrative duties; R. C. Churcher to command No. 216 Squadron, R.A.F. Lyneham; G. Goodsell to H.Q., Maintenance Command, for administrative staff duties; R. S. Harries to H.Q., Maintenance Command, for air staff duties; H. P. Hopkins to R.A.F. Shawbury, for A.T.C. duties; E. James to H.Q., Fighter Command, for air staff duties; J. E. Lewis to H.Q., Allied Forces Mediterranean, for staff duties; J. E. M. Mould to Air Ministry, for duty in the Department of the Air Member for Supply and Organization; B. J. Paul to R.A.F. Melksham, for administrative duties; B. E. Peck to Air Ministry, for duty in the Department of the C.A.S.; A. H. C. Roberts to Air Ministry, for duty in the Department of the C.A.S.; M. J. Underhill to Air Ministry, for duty in the Department of the Air Member for Supply and Organization.

S/L. F. K. Hindle to the School of Administration, Bircham Newton, to instruct (with acting rank of wing commander).

Display Participants

SIX Hunter F.6s of No. 63 Sqn. (S/L. S. Walker), R.A.F. Waterbeach, are to fly over Jersey and Guernsey on September 18 as part of the Battle of Britain Week celebrations organized by the Jersey branch of the R.A.F.A. The Jet Provost aerobatic team from the C.F.S., Little Rissington, will also take part in the Jersey display.

IN BRIEF

R.N.A.S. Culdrose is to receive the freedom of Helston today (September 12).

* * * * *

Vampires of No. 1 Sqn., Royal Rhodesian Air Force, have returned to Southern Rhodesia after temporary duty with the R.A.F. at Aden.

* * * * *

A recruiting campaign is to be launched for the twelve R.Aux.A.F. Fighter Control Units. These are based on Aberdeen; Belfast, Bournemouth, Dundee, Eastbourne, Hull, Ipswich, Leeds, London, Newcastle, Norwich and Peterborough

* * * * *

The Junior and Senior Lord Wakefield Novices' Boxing Competitions are to be held at R.A.F. South Cerney from October 13 to 15. The present title-holders (who are again competing) are R.A.F. Church Fenton and Bridgnorth respectively.

* * * * *

The R.A.F. hospital at Rostrup in Germany, which has treated 34,000 patients of six nationalities since it was re-formed as No. 1 Mobile Field Hospital at Rinteln in April 1952, is to be handed over to the Germans. It originated as No. 1 Medical Receiving Station (a mobile tented unit) on August 25, 1939.

The R.C.A.F. team from 4th A.T.A.F. (flying Sabre 6s) which won the recent NATO air-to-air firing competition for the Guynemer Trophy. From left to right, F/L. C. J. Henry, F/L. W. Norn, F/O. D. Barker, F/L. R. MacGarva (captain) and F/O. R. Paul. The contest was at Cazaux.

S/L. V. Guthrie, leading parachute instructor of the R.A.A.F. (right), at R.A.A.F. Point Cook with four cadets from the three Indian armed services who have been touring Australia as guests of the Australian Government.

CIVIL AVIATION

Today, September 12, the new 8,340ft runway built out into Kowloon Bay at Kai Tak, Hong Kong, is due to be officially opened by the Governor, Sir Robert Black. Among the visiting aircraft will be a Comet 4 for B.O.A.C., operated by de Havilland.

THE NEW MARKET

IT is now possible to speculate on the implications of the British aircraft industry's newly permitted freedom to trade with the Communist bloc. Till last month when the ban on the export of many strategic goods was lifted, the British industry was not allowed to sell a single item of equipment of any kind to Communist countries.

British aircraft salesmen will quickly learn the extent to which the Russian industry now dominates the Communist airlines, all of which—with the one exception of LOT Polish Airlines—are Soviet equipped. Competition with the Soviet industry is likely to be felt in terms more of price than of quality, and it may furthermore be supposed that few airlines in the Sino-Soviet bloc possess much sovereignty of choice when it comes to a decision between Russian and Western built aircraft. However, there are indications that Poland and Czechoslovakia are keenly interested in sampling British aircraft; LOT have been discussing Comets with de Havilland and Viscounts and Vanguards with Vickers, while C.S.A. are also known to be strongly interested in the Viscount.

The permit allows the sale of aircraft weighing up to 90,000 lb "empty weight" (i.e., the complete aircraft plus crew, excluding passengers and fuel). This means that all British civil aircraft in production will qualify for Communist patronage. It is understood that the 90,000 lb limitation will not apply to aircraft when they have been in service for two or more years.

IMPROVED VISCOUNT 810

AS briefly noted in last week's issue, the Viscount 810 is now being offered to carriers at an increased maximum take-off weight—72,500 lb instead of 69,000 lb. A particularly important fact is that this will permit an extension of range with maximum payload of 15,000 lb (equivalent to 75 economy-class passengers) from the present distance of 800 miles with fuel reserves to 1,200 miles.

Equipped with two slipper tanks of 250 Imp. gal capacity each, this new version will be able to carry a payload of 10,400 lb over a 1,650-mile sector with reserves.

VERBAL COMPETITION

A WHOLE section of B.O.A.C.'s latest annual report discussed the factors affecting the Corporation's results, and in our issue of August 22 ("Safari Competition") it was argued that B.O.A.C. was hardly justified in devoting more space in this section to competition from Safari services than to the business recession.

The controversy was revived last week with publication by Hunting-Clan of a provocative "reply to B.O.A.C." which unfortunately appears to confuse rather than clarify. The main points are as follows: B.O.A.C. could have eased its earlier equipment difficulties by chartering H.C.A. Viscounts; Viscounts were "not allowed" on Colonial Coach services until B.O.A.C.'s Britannias were in operation; fears of traffic being inadequate to support a three-tier fare structure have been shown to be unjustified; Safari services have generated new traffic; B.O.A.C. seeks to "eliminate" the Safari services; the extent of Safari operations is too small to constitute a real threat; the Air Transport Advisory Council states that material diversion has not taken place ("thus B.O.A.C.'s statement in effect says that the A.T.A.C. has been incompetent in its work").

What is in fact a very strong case for the Safari operators appears to have been weakened by leaving a number of points open to counter-attack. For instance, B.O.A.C., through its subsidiary M.E.A., leased H.C.A.'s three V.732s from 1955 to 1957, employing them on services obviously more suited to the Viscount than the Corporation's African operations; no evidence is given in support of the contention that Viscounts were banned from Safari services until B.O.A.C.'s Britannias were in operation; diversion is not disproved by Safari flights being full while the Corporation has seats to spare; B.O.A.C.'s intention to operate economy-class services does not prove that it is "attempting to set up a monopoly"; and, of course, disagreement between a route-awarding agency and an airline does not necessarily suggest incompetence of the agency.

NORTH ATLANTIC INTERIM REPORT

THE advent of economy class services across the Atlantic is causing some concern as capacity has been ambitiously expanded at about twice the rate of traffic growth (see *Flight*, August 22). Figures for individual airlines are now available and it is interesting to notice the wide variation experienced in the first six months of this year.

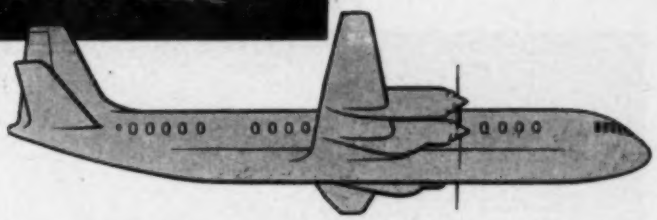
Possibly the most significant single feature that appears from the latest U.S. - Europe traffic figures is that the two American carriers —PanAm and T.W.A.—are primary responsible for the increased number of unsold seats. Throughout last year these two provided 48 per cent of total capacity: in the first half of this year their share of capacity rose to 56 per cent. But as European carriers managed to sell a higher proportion of their capacity (average load factor 59 per cent as against 55 per cent for PanAm and 53 for T.W.A.), the American share of traffic carried fell from 48 to 43 per cent. With the exception of Air France, Iberia and K.L.M., all European airlines increased substantially their share of total traffic (the shares for Air France and Iberia remained constant at 9 and 1 per cent respectively, while K.L.M.'s share fell from 8.4 to 7.4 per cent).

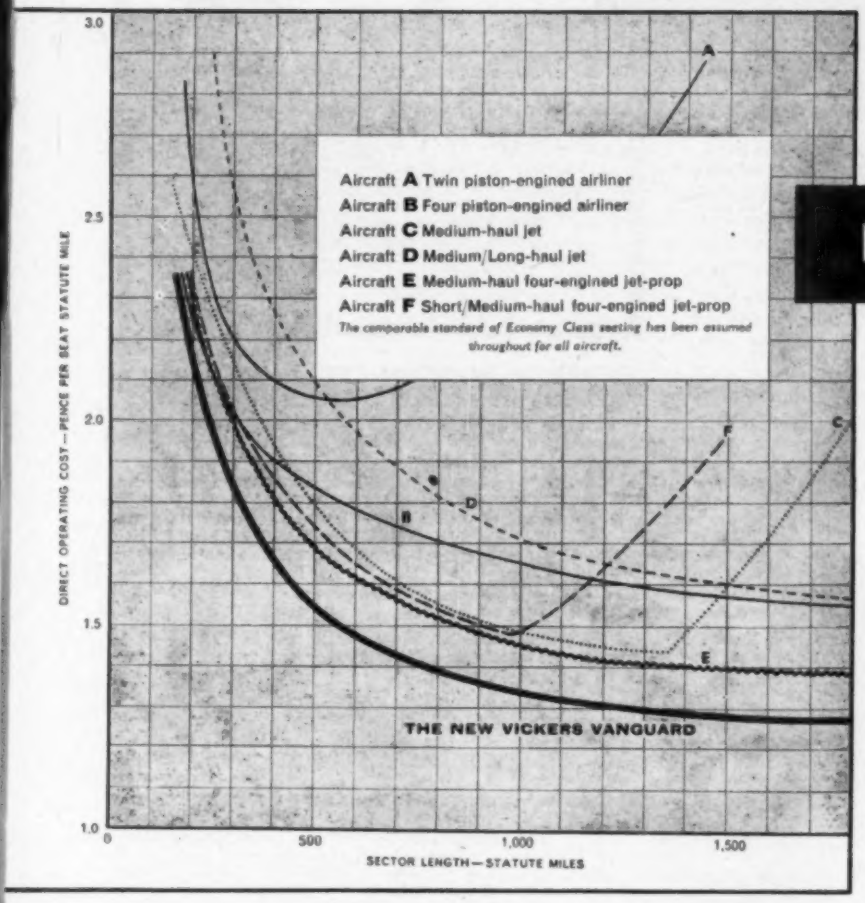
The range of average load-factors among European carriers was remarkably wide. The two Britannia operators, B.O.A.C. and El Al, showed the highest average loads (about 65 per cent). At the other extreme are Qantas (41 per cent) and Iberia (34 per cent). Alitalia, Sabena and (surprisingly) K.L.M. show relatively poor load-factors in the low fifties.

The rise in the European airlines' share of total traffic (and their relatively high load-factors) stems from extraordinarily high east-bound load-factors on economy-class services (75 per cent).

Here is the first air-to-air photograph of the good-looking Grumman Gulfstream 12-passenger executive transport (two Rolls-Royce Dart RDa.7/2 Mk 529s) which made its maiden flight on August 14 at Bethpage, N.Y. The company claims to have received orders for 27 aircraft to date. Deliveries can be made next year.

LOWER FARES





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MORE PROFIT

The success of economy class on the North Atlantic air routes (60% of all North Atlantic passengers now travel at economy fares) has proved the passenger attraction of the cheap rate ticket.

On short and medium-haul such traffic-boosting fare reductions can be made possible by one aircraft and one aircraft only — the Vickers Vanguard.

In economy class the Vanguard has over 50% greater profit potential than any competitive air liner and has, by a substantial margin, the lowest seat-mile cost on offer today.

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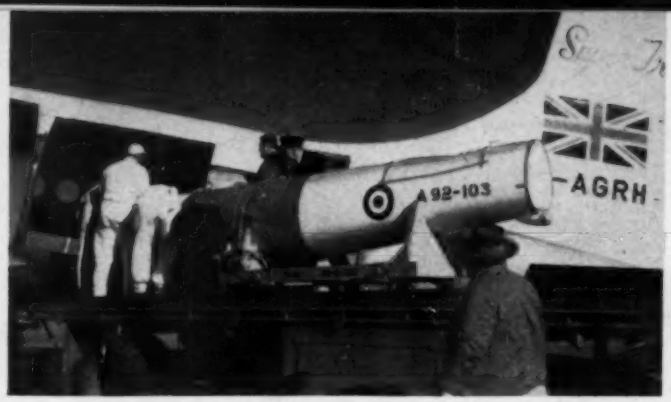

This Avro Super Trader of Air Charter is seen at Melbourne taking aboard one of four Jindivik pilotless target aircraft, part of an order for ten Jindiviks placed by the Ministry of Supply.

CIVIL AVIATION . . .

B.O.A.C.'s 84 per cent load-factor was the highest in this particular field.

The proportion of economy-class traffic to each airline's total varied from one-sixth for Qantas to about two-thirds for El Al, a typical average being about one-third. The proportion was over one-half for three European carriers—Alitalia, Sabena and S.A.S.

EXPENSIVE EXPANSION FOR ALITALIA . . .

ITALY'S one remaining national carrier provides a notable exception to the general rule of airlines improving their overall position by expanding into long-haul markets. In 1953 Alitalia returned a profit of £155,000 on revenue of only £2.1m. By 1956 it had started to acquire a short-haul network and, although revenue had more than doubled to £4.4m, profits had slumped to £28,000. Last year this proces was given further impetus by the acquisition of L.A.I., revenue jumping to a record £7.4m, profits falling to the lowest figure for six years, £3,308.

L.A.I.'s operations were taken over in August, but the merger was only completed in November. At the year end Alitalia emerged with twice as much capital (L.10,000m as against L.4,500m in 1956), the I.R.I. (Italian Reconstruction Institute) holding about three-quarters of the shares, private Italian interests about 15 per cent and British airlines the remaining 13.5 per cent (B.E.A. 9 per cent, B.O.A.C. 4.5 per cent).

Alitalia's capacity in 1957 increased by 55 per cent to 49m c.t.m.s while traffic rose even more rapidly, by 59 per cent, to 28m l.t.m.s (load factor 57 per cent). The most successful routes were those to Caracas, East and South Africa, Beirut and Geneva; unsatisfactory results were experienced on North and South Atlantic, intra-European and domestic routes.

. . . AND FOR LUFTHANSA

MEASURED financially, Deutsche Lufthansa last year came off even worse than Alitalia. Following a growth pattern similar to the Italian carrier's, DLH's capacity increased by 48 per cent to 73m c.t.m.s while traffic rose by as much as 66 per cent to 38m l.t.m.s. But the gain from the consequent rise in load factor from 48 to 53 per cent was completely offset by a fall in the average revenue rate and a rise in unit costs. Inability to close the gap between ton-mile costs and revenues on an increased scale of business led to an inevitable rise in Lufthansa's deficit from DM20m (£2.3m) to DM27m (£3.2m). As in past years, this loss has been covered by subsidies received from the airline's main shareholders, the Federal Government and the State of North Rhine-Westphalia.

Until DLH settles down to a period of consolidation rather than of continuing meteoric expansion, it seems improbable that the airline's chronic problem of rising costs and poor load-factors will be solved. And such a stage is unlikely to be reached this year with two new fleets—four L.1649As and nine Viscount 814Ds—being brought into operation.

THE VIKING ACCIDENT

LAST Tuesday morning Vickers Viking G-AIJE, one of five owned by Independent Air Travel, crashed soon after taking off from London Airport, en route to Nice and Tel Aviv. The aircraft was reported to be carrying a load of spare Proteus engines bound for El Al. Conditions at the time of the crash, which occurred at about 0730 hr, 40 minutes after take-off, were very misty. The Viking came down on houses in Southall, Middlesex, demolishing three and causing heavy casualties. As *Flight* went to press it was understood that four occupants of the houses had been killed and eight seriously injured. There were no passengers on board the Viking, whose crew of three lost their lives. The pilot was Captain P. E. W. Mayger, co-pilot was Mr. Gerald Altena and the engineer was Mr. Denis Howard. It is understood that the aircraft was heading for Blackbushe with engine trouble.

AFRICA'S LEADING INDEPENDENT

SELDOM seen in the U.K. but frequent visitors to airports on the Continent, Trek Airways' smart red and white DC-4s ply a growing trade between South Africa and Europe. This year should see 6,000 passengers make use of their non-scheduled intercontinental services.

Last winter Trek purchased two DC-4s from Northwest Airlines and put them on to the Johannesburg - Europe route in April—replacing their three Vikings, which were then released for charter flying. The South African National Transport Commission only sanctioned the dollar purchase of these aircraft on condition that the number of round flights per month be limited to a maximum of five.

Although strictly speaking a non-scheduled carrier, Trek Airways operate a pre-arranged flight programme extending as much as a year ahead. As far as the Union Government is concerned the airline is at liberty to carry individually paying passengers. As regards European rights, Trek has access to unrestricted traffic at Dusseldorf and Luxembourg (subject only to prior confirmation) and has permission to make two traffic stops a month at Paris, Nice, Zurich and Vienna. At each of these points Trek can pick up individually paying passengers, but in the U.K. it is limited to group charter (in which all aircraft space is booked by a single person or *bona fide* organization).

Flights originate at Jan Smuts airport, Johannesburg, and usually terminate at Dusseldorf, or less frequently at Luxembourg or Paris. Round flights are programmed to take nine days, allowing a crew rest-day at the European terminal and overnight stops at Entebbe, Cairo and (as alternates) Nice, Zurich or Vienna. An alternative route passes through Palma, Kano, Leopoldville and Windhoek. The present operating plan only gives an annual utilization rate of about 1,600 hr per aircraft. Higher rates are not possible under present licensing arrangements and would in any case leave little flexibility to accommodate an unexpectedly sudden change in programme.

The DC-4s were taken over in extremely good condition (unlike most of this type, they are not converted C-54s but were originally built as civil airliners), and since being put into service for Trek have not provided a single instance of an unscheduled engine change. Trek maintain the aircraft at their Johannesburg base (S.A.A.'s many years' operation of DC-4s on internal services has led to the ready availability of DC-4 know-how and equipment) although engine overhauls are carried out in Stockholm by S.A.S. on a powerplant-replacement basis.

Management is based on the Johannesburg office, each of the directors taking an energetic part in day-to-day business. Chairman of the Board and financial director is Mr. W. B. Rorke. Of the other directors, Capt. Tom Meredith (operations director) and Capt. Cecil Snelgar (technical director) are both active pilots, and Maj-Gen. F. W. von Mellinthin (who was Rommel's chief-of-staff) is commercial director. Mr. W. E. Hamilton, European

Since Fairchild delivered their first F-27 Friendship in June to West Coast Airlines more than a dozen production aircraft have been rolled out of the Hagerstown factory. This picture shows the 36-seat layout adopted by West Coast, and is the first glimpse of an airline-furnished F-27. Meanwhile production by the parent factory Fokker is getting into its stride, and the first deliveries will be made next month to Aer Lingus, for Dublin - Paris service on November 1.

CIVIL AVIATION . . .

director, keeps an eye on the airline's European activities from his London office.

Promoting a non-scheduled service is always a difficult problem. Trek Airways have found that "our best advertisement is a satisfied passenger," their main form of publicity being word-of-mouth recommendation on the standard of service and on the level of fare (£117 single Dusseldorf - Johannesburg as against I.A.T.A. fares of £224 first-class and £152 tourist). This is reinforced by direct approaches to the travel trade and to the agencies responsible for emigration (such as the 1820 Settlers Association and the Johannesburg Chamber of Mines). In Europe and North America Trek works closely with Icelandic Airlines (Loftleidir) which in turn offers cheap fares in DC-4s across the North Atlantic. Trekair also works closely with an associated local travel agency, South African Skytours, and their British representatives, Safari Travel, Ltd. European bookings are controlled from newly opened London sales- and administrative-offices in Northumberland Avenue. An interesting feature of these offices is that they are adjacent to "the Safari Club," an institution associated with Trekair and catering especially for the social needs of overseas visitors to London.

A peculiar sales difficulty that faces Trekair is the erratic past history of non-scheduled services between South Africa and Europe. People can still be met who tell tales of having paid the fare for an air passage that never materialized. Shortly after the war five South African non-scheduled companies—Alpha, Mercury, Pan African, Suidair and Universal—started operating with a mixed fleet of Haltons, Vikings and DC-3s, but of these only one (Pan African, using DC-3s) survived into the early fifties. Meanwhile two charter companies—William Dempster, operating three Tudors, and Meredith Air Transport, operating one DC-3—had been formed in the U.K. to operate across Africa. In 1951 Dempster and Pan African became involved in legal difficulties (which led to the dissolution of both companies). In 1950 Tropic Airways had been formed and the following year started operations with a DC-3. In 1952 this aircraft was lost in the Mediterranean and replaced by a York (the late Jan Smuts' private aircraft *Cubaas*), but personal differences at Board level led to the company's breaking up in 1953. Capt. Harry Creed continued operations with the York under the name Creed Air Transport, and later as Tropic Airways 1955, Ltd., but this company was also liquidated. The two other Tropic directors, Messrs. Meredith and Hamilton, broke away in 1953 to form Trek Airways, raising the necessary capital by the sale of their (Meredith Air Transport) DC-3 to Davies and Newman; this marked the foundation of Dan-Air. The following year Trek put three ex-Airwork Vikings into operation on the S. Africa - Europe route, and these aircraft remained in use until their replacement by DC-4s last spring when they were transferred to the British register under the name African Air Safaris (the successor company to Meredith Air Transport). In 1956 African Air Safaris acquired an ex-B.O.A.C. Hermes for use by Trekair, but this aircraft was found to be unsuitable and has since been transferred to Britavia on long-term bare-hull charter. The Vikings are at present also on charter to British independents.

BREVITIES

THE sale has just been announced of the four-hundredth Viscount, a 745D (ex-Capital) to the Kuwait Oil Company.

* * *

To date ten Boeing 707-120s have been rolled out, and nine more are in final assembly. Six are for Pan American and four for American.

* * *

Swissair are expected to decide soon on the purchase of jet aircraft for their short-haul routes.

* * *

Reports of a new Lockheed commercial freighter based on the C-130 suggest a gross weight of 145,000 lb.

* * *

Pending delivery of their two Comet 4s in 1960, East African Airways expect to charter two Britannia 312s from B.O.A.C. for operation on the London - Nairobi route.

* * *

Continental have applied to the C.A.B. to introduce an "economy-class" fare between Chicago and New York at a level 20 per cent below the present coach (tourist-class) fare.

* * *

The annual general meeting of the International Union of Aviation Insurers was taking place in Western Germany at Garmisch-Partenkirchen on September 10 and 11. Special subjects to be discussed included atomic risks and jet aircraft.

The president of Aerolineas Argentinas, Comodoro Juan Jose Guiraldes (right) arriving at London Airport last week. The Argentinian national carrier will start to take delivery of a fleet of six Comet 4s this winter.

Real Aerovias Nacional (Latin America's largest airline) has become a member of I.A.T.A., bringing membership to 86.

* * *

Mr. P. C. Garratt, managing director of de Havilland Canada, recently back from Russia, has quoted $900,000 as the Il-18's price.

* * *

A revised edition of *The New Complete Guide to London Airport* by Sir Miles Thomas is now available, price 2s 6d. It is published by Pitkin Pictorials, Ltd., and is one of the "Pride of Britain" series.

* * *

A revised edition of *Civil Aircraft Recognition*, published by Ian Allan, price 2s 6d, is now available. Edited by John W. R. Taylor it contains photographs, three-view drawings and data on the world's civil aircraft.

* * *

Swissair have chartered a Douglas DC-6B from American Airlines for use on the European and Middle Eastern network. The charter is for two years and brings to seven the number of DC-6Bs operated by Swissair.

* * *

Boeing claim to have reduced 707 sound level by 12 db, by far the biggest reduction ever claimed. Reduction of 6 db is guaranteed. To date Boeing has spent more than $10 million on noise suppression devices, which are now used in conjunction with thrust reversers, also a Boeing design.

* * *

Silver City announce their greatest monthly cross-Channel motor-car uplift during August. The British independent's Bristol Freighters carried 14,070 vehicles including 11,720 motor-cars. This was the first time that more than 10,000 motor-cars had been flown across the Channel in one month.

NAGPUR JUNCTION (contd. from page 465)

From now on it is as if the military has taken over. The passengers make for the restaurant or catch up on their disturbed sleep on the lawns outside the terminal building; but on the apron the main action of the night is on.

Each aircraft faces an illuminated sign showing its destination and at the hatches of each machine is a truck manned by four loaders and a traffic officer. Two loaders move into the aircraft and shift the load on to the truck. The trucks move round to despatch each sector's mail and freight into its appropriate aircraft, where it is again lashed down ready for take-off. The apron at this time is alive with moving trucks and men casting dark shadows under the floodlights, and fuel bowsers glide from aircraft to aircraft filling their tanks for the onward journeys. Indeed, to the NAM passenger Nagpur seems a pool of light and movement lying at the heart of a darkened India.

After the load transference, the passengers are roused and sorted out, and then the local Farnborough air display begins. At 03.10 the Calcutta DC-4 takes-off, at 03.15 the Bombay DC-4, at 03.20 the DC-3 for Delhi, at 03.25 the Madras DC-4, and then at 03.35 the Delhi Viscount. Each aircraft flies off with headlights on, one engine roar takes over as the other fades, and the whole exciting furore of action and sound is drawn to a close with the whine of the Darts. Then Nagpur junction shuts up for the night.

OPERATIONS TO NAGPUR

From	Pass.	Mail	Freight	Stores	Aircraft
Calcutta	42	2,680 lb	1,931 lb	501 lb	DC-4 VT-DIB
Bombay	39	3,956 lb	2,191 lb	67 lb	DC-4 VT-DAW
Delhi	30	2,188 lb	1,478 lb	56 lb	Viscount VT-DIG and DC-3 VT-CTZ
Madras	44	2,011 lb	1,013 lb	41 lb	DC-4 VT-CZT
OPERATIONS FROM NAGPUR					
Calcutta	37	2,803 lb	1,101 lb	171 lb	DC-4 VT-CZT
Bombay	27	2,393 lb	1,771 lb	43 lb	DC-4 VT-DIB
Delhi	44	3,102 lb	970 lb	405 lb	Viscount VT-DIG and DC-3 VT-CTZ
Madras	39	2,326 lb	1,923 lb	—	DC-4 VT-DAW

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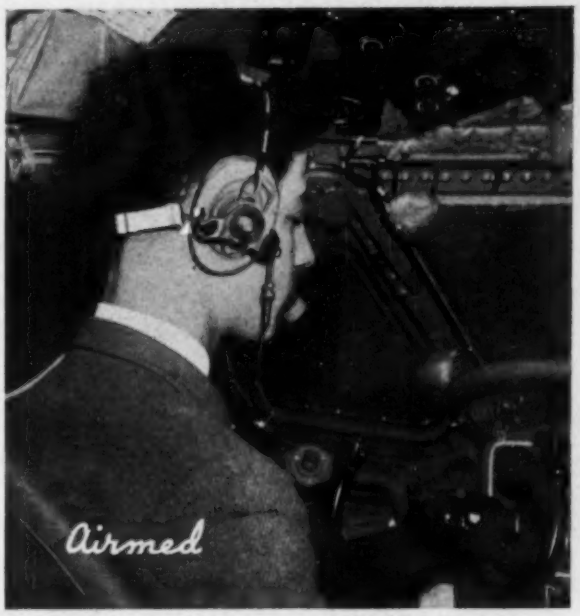

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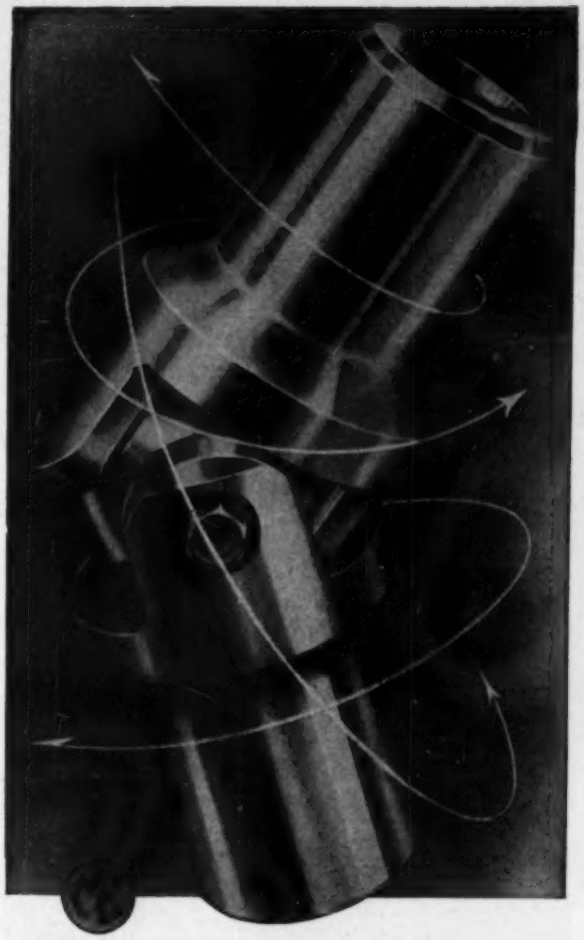

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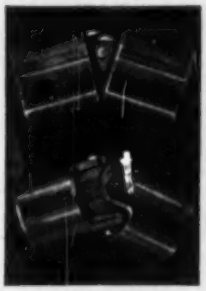

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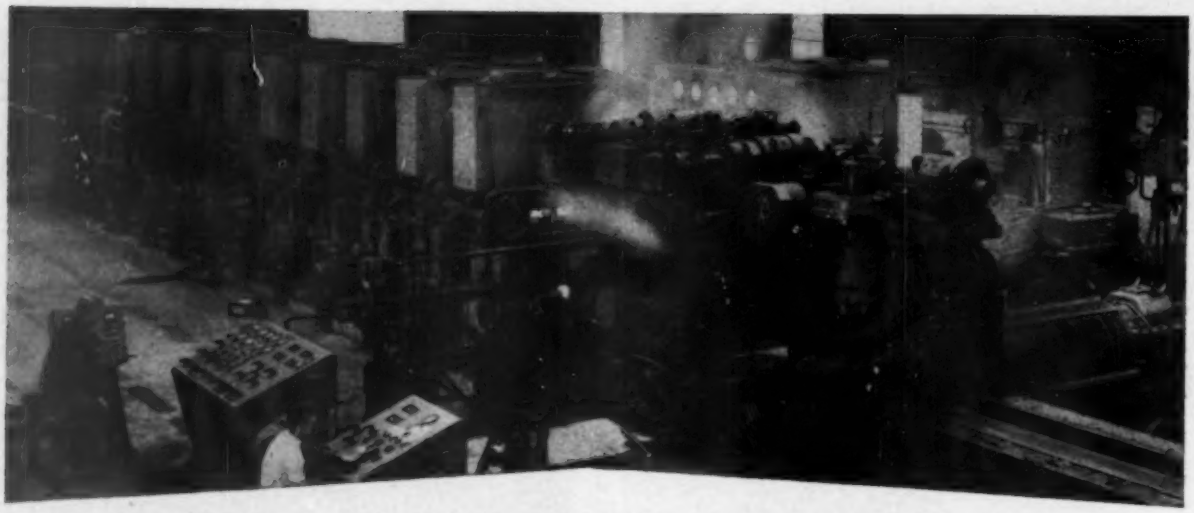

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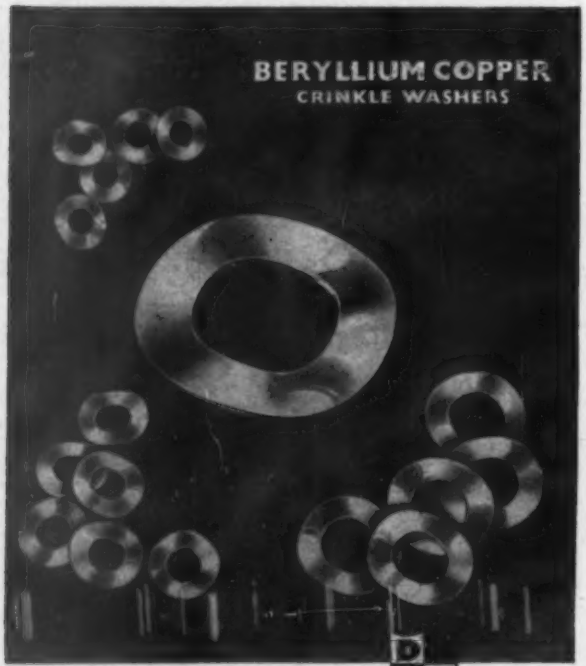

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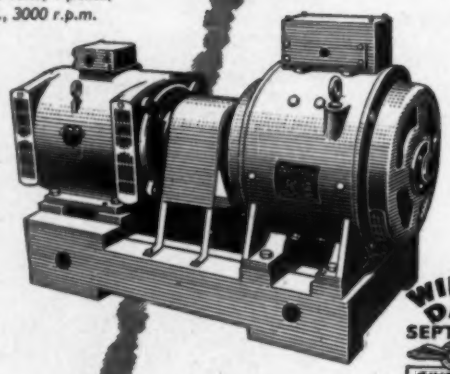

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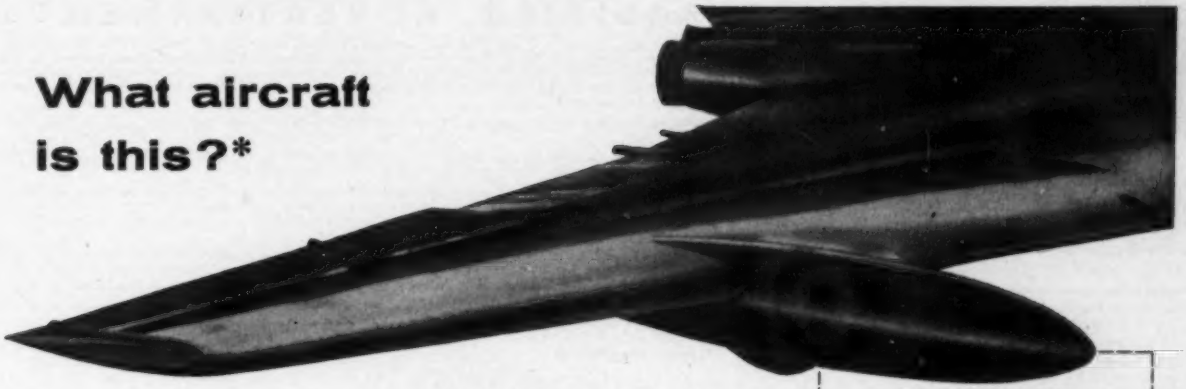

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*See page 61 for answer

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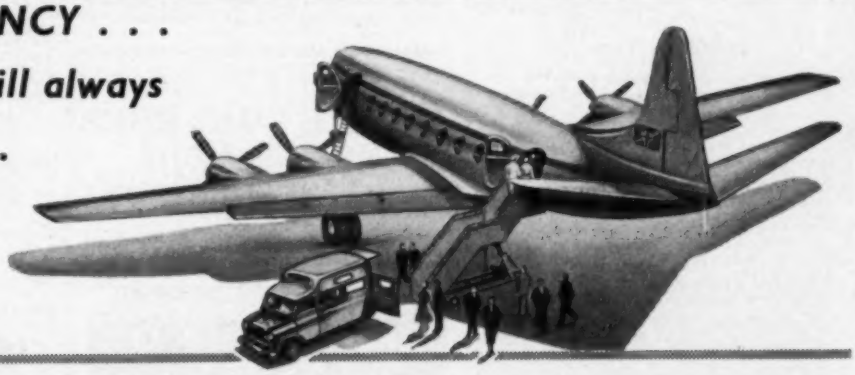

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Thursday, 25 September: Derby, Birmingham.
Friday, 26 September: Cardiff, Swansea.
Saturday, 27 September: Plymouth, Exeter.
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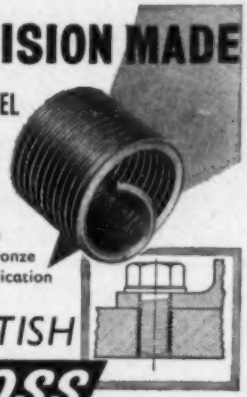

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THE AIR TRANSPORT ADVISORY COUNCIL give notice that they have received the undermentioned applications to operate scheduled air services:—

FROM Silver City Airways, Ltd., of 62 Brompton Road, London, S.W.3—

Application No. 2219 for a seasonal normal scheduled service with Heron, Dakota and B.170 aircraft for the carriage of passengers, and supplementary freight between Blackpool and Dublin at a frequency of three return flights weekly from mid-March to September 30 each year for seven years from 1959.

FROM B.K.S. Air Transport of Berk House, Baker Street, London, W.1:—

Application No. 2222 for a normal scheduled service with Dakota and Ambassador aircraft for the carriage of passengers, supplementary freight and mail on the route Southend - Dinard - La Baule (opt.) at a frequency in accordance with traffic demand for seven years from April 1, 1959.

FROM East Anglican Flying Services, Ltd., of Southend Airport, Essex:—

Application No. 2223 for a normal scheduled service initially with Viking aircraft and later also with Herald and Ambassador aircraft for the carriage of passengers, supplementary freight and mail on the route Jersey - Oporto - Tangier or Casablanca - Las Palmas at initial frequency of one return flight weekly increasing later to two return flights weekly for ten years from November 1, 1958.

THESE applications will be considered by the Council under the Terms of Reference issued to them by the Minister of Civil Aviation on July 30, 1952. Any representations or objections with regard to these applications must be made in writing, stating the reasons and must reach the Council within 14 days of the date of this advertisement, addressed to the Secretary, Air Transport Advisory Council, 3 Dean's Yard, London, S.W.1, from whom further details of the applications may be obtained. When an objection is made to an application by another air transport company on the grounds that they are applying to operate the route or part of route in question, their application, if not already submitted to the Council, should reach them within the period allowed for the making of representations or objections. [8256

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Printed in Great Britain for the Publishers, ILIFFE & SONS LTD., Dorset House, Stamford Street, London, S.E.1, by SUN PRINTERS LTD., Watford and London. *Flight* can be obtained abroad from the following: AUSTRALIA AND NEW ZEALAND: Gordon & Gotch, Ltd. INDIA: A. H. Wheeler & Co. CANADA: The Wm. Dawson Subscription Service, Ltd., Gordon & Gotch Ltd. SOUTH AFRICA: Central News Agency, Ltd.; Wm. Dawson & Sons (S.A.), Ltd. UNITED STATES: Eastern News Co., 306 West 11th Street, New York 14.

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